Comparative ethnographical studies.

9.

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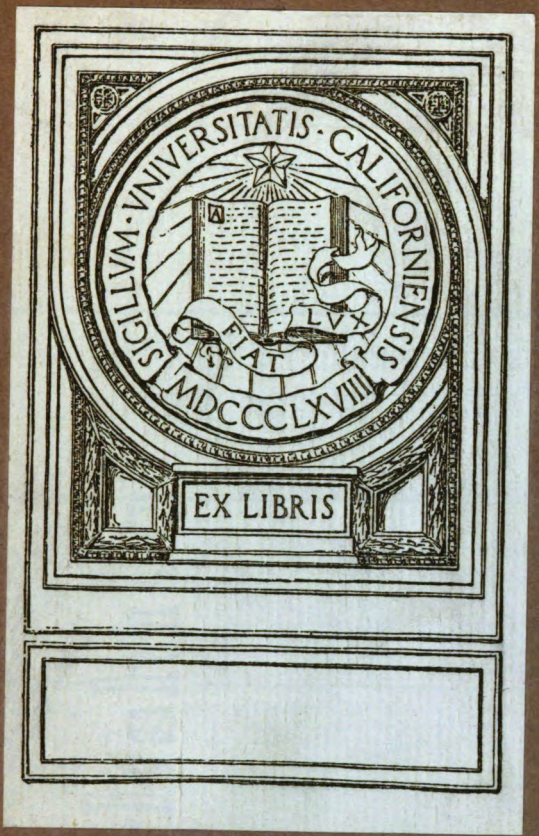
Edited by

Erland Nordenskiöld



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PREFACE.

The publication of the present volume 9 of Comparative Ethnographical Studies has been rendered possible through the financial support given by Th. and Hanne Mannheimer's Fund, and to its Trustees, H. Mannheimer, Esq. and Dr. Carl Mannheimer, I herewith beg to express my sincere thanks.

Erland Nordenskiöld.

GÖTEBORG 1931
ELANDERS BOKTRYCKERI AKTIEBOLAG

ORIGIN OF THE INDIAN CIVILIZATIONS IN SOUTH AMERICA

BY

ERLAND NORDENSKIÖLD

WITH APPENDIXES BY

STIG RYDÉN, AXEL HULTGREN, G. PHRAGMÉN AND KARL IZIKOWITZ.

Migrations from North America to South America.

When studying the problem of the origin of the Indian civilizations in South America we must bear in mind that we cannot speak of a North American, a Central American and a South American Indian culture as being the opposites of each other. It is a very characteristic fact that incomparably greater similarity exists between civilizations as far apart as those of the Calchaquis of Argentina and the Pueblos of North America than between the culture of any Indian tribe and that of any people in the whole of Oceania. One or other of Fennimore Cooper's books of adventure on North American Indians might, after some slight revision, read as if dealing with, e. g., the Abipones or the Araucanians, but by no stretch of imagination could it be located in Polynesia, Melanesia or Indonesia. Between the ancient high cultures of Peru and Mexico there were great divergences but at the same time they had much in common, not only of an external character but also as regards the mental qualities of the peoples by whom they had been built up. A treatise on the origin of the Indian civilizations in South America must therefore at the very outset concern itself with comparing the Indian cultures of North, Central and South America.

The main route of migrations from the Old World to America is supposed to have been via arctic regions, i. e. Bering Strait, but it is nevertheless in tropical and sub-tropical tracts that Indian culture is found at its richest. In South America,

culture is but poorly represented in its sub-arctic region. The important questions are therefore to what extent tropical and sub-tropical culture in America constitutes an adaptation on the part of peoples, previously inhabitants of arctic regions or the temperate zone, to different natural surroundings; to what extent that culture is authochthonous to America, and to what extent we have to seek its origin in migrations and direct cultural impulses from across the oceans. These are the problems that I shall try here to find some answer to.

If we compare South American Indian culture with that of Central and North America we shall find that the South American Indians knew a great many things which in pre-Columbian times were unknown in other parts of America. Many of these culture elements were in pre-Columbian times unknown in the Old World as well as in Oceania, which proves them to have been discovered or invented by the Indians of South America.[1]

It is evident that in many parts of South America the Indians have excellently adapted themselves to their environment and learnt to turn to account the material resources of Nature. This applies above all to the peoples of the western culture area and the agricultural tribes in the Amazonas territory. For the moment we may content ourselves with establishing that these peoples have made quite a number of discoveries and inventions that were unknown in the Old World. In the regions just referred to they have discovered many cultivable plants, including manioc, which next to maize is the most important food plant in the whole of America. They have invented all that apparatus which is necessary for the utilization of the poisonous manioc as food; they knew how to extract a poison like curare, as well as several narcotics. Rubber they made use of in several ways, and in this connection they invented

[1] See Part 8 of my "Series".

the hollow rubber ball, elastic rings, and the enema syringe. The use of narcotic clysters was known by them. In the stoneless areas of the Amazonas territory they have put burnt clay to a variety of uses as a substitute for stone. In their pottery-making, the clay was, among other things, reinforced with sponge spicules. The Indians of the Amazonas have also in different departments achieved numerous minor inventions that were unknown in the Old World prior to the days of Columbus; inventions not directly connected with the presence of newly discovered cultivable plants or with any specific raw material, such as quaint musical instruments, vessels with a hollow rim containing baked clay pellets, etc. To these may be added improvements or modifications affecting arrows and blowguns, baskets, etc. The exact localities where these different inventions originated are presumably extremely difficult to determine. Many of them, such as curare, the rubber ball, etc., seem to be distributed mainly north of the Amazon river.

In the western culture area, too, adjustment was similarly made to environment, and also discoveries and inventions that in pre-Columbian times were unknown outside South America. Here the Indians discovered and cultivated new economic plants, such as potatoes, oca, quinoa, etc. They domesticated certain animals, such as, among others, the llama, which they trained to carry loads. Also in other directions they advanced ahead of the Old World of pre-Columbian times. Thus they invented saw-toothed fortified walls[1], copper-welding,[2] cutting tools of the alloy Au—Ag—Cu,[3] quipus with the knots arranged according to the decimal system, etc.

If we eliminate such culture elements as must have been

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[1] E. g. Sacsahuaman.

[2] *Hultgren.*

[3] See Appendix.

discovered or invented in South America because they were absent in the rest of the world, there remain a good many which in America are only known from certain parts of South America (including the West Indies) and at the same time from the Old World.

It is difficult to imagine that these may have come from Asia to South America via North America without at all surviving in any part of the last-mentioned half of the continent. As regards part of them it is moreover improbable that they have entered by that route by reason of their use being restricted to tropical and sub-tropical regions. On the other hand we must take into account the possibility of their having been imported into South America directly from across the oceans, provided, of course, that even these elements have not been independently invented in South America. This is a point to which I shall recur later. For the present we may restrict ourselves to recording the fact that at any rate the agricultural Indians of the Amazonas, as well as the Indians of the western civilization area, have most admirably adjusted themselves to their respective environments, and that in various ways they have found use for a large number of plants which they have either cultivated, or else in some manner or other utilized in the wild state. *The fact having been proved that the Indians have achieved many discoveries and inventions should always be borne in mind when discussing parallels between Indian, Oceanic and Asiatic cultures.*

As we know, at the time of the discovery of America the white man came upon a continent where, on the whole, the natural resources were known and utilized by the Indians. It cannot be said with any degree of certainty that either the whites or the negroes have there discovered any economic or medicinal plant of importance which was unknown to the Indians.

Among North American Indians north of Mexico we find remarkably few inventions that are not known in other

parts of the world. The inventions that the South American Indians must have made, because they were unknown in the Old World, have as a rule not spread to North America, for reasons not unconnected with the fact that some of them probably were made at a relatively late date. Others may simply not have been in demand outside some particular limited area.

Apart from the Chibchan languages, spoken by tribes inhabiting portions of the Isthmus of Panama bordering upon South America, it has not been possible to point to any language common to Central and South America[1] Judging from everything, it is Chibcha tribes who have immigrated to Central America from South America, and not vice versa. Neither has any affinity been shown to exist between languages of South America and North America,[2] respectively, except that certain Arawaks probably not long before the Discovery immigrated to Florida from the Antilles. All important movements of peoples from Central and North America to South America must therefore in all probability date back to exceedingly remote times,[3] as otherwise — at our present-day stage of scientific progress — they should be capable of being linguistically proved, like the great migrations within the North and South American continents.

Even such migrations as those of the Arawaks as can be proved linguistically must date from very far back by reason of their having caused very considerable differentiation in culture. From all we know so far of Indian and Eskimo languages we find that the space of some hundreds of years produces very little change in them. In many instances it is easily ascertained that Indian languages of which we

[1] Here I am leaving out of account the post-Columbian forcible transportation of Caribs to Honduras.

[2] *Lehmann* (1), p. 339.

[3] How long ago, we cannot tell. In similar cases we are reduced to expressing ourselves in vague terms.

have notations made in the 16th and 17th centuries have not undergone much further change than having incorporated a considerable number of loan-words from Spanish or Portuguese.

Even if we suppose — as we have reason to do — that no important migrations from North and Central America to South America have taken place for a very great length of time, we ought, of course, to admit that there have been such, as otherwise we are forced to assume that South America has received all its population directly from overseas. Even if there has been some migration from North America to South America via the Antilles, it is likely to have taken place at a very remote date, seeing that the Antilles have so obviously received their Arawakan and Caribbean cultures and populations from South America. The Arawaks, as already mentioned, have even penetrated as far as the coast of Florida, and it is not impossible that by this means some South American culture element or other, e. g., the boucan, has reached North America by way of the Antilles. Hence the question arises: Are we, from a study of present-day Indian culture, and assisted by archaeology, in a position to learn something of these migrations which took place in a very remote past?

In this connection we may first of all note the existence in the extreme south and the southern regions of South America, in the present time or formerly, of a large number of culture elements which are also found in North America, but not at all, or merely sporadically, in the Amazonas, northern South America, Central America and the West Indies. Some of these occur exclusively in the south, others mainly in the south-west, while others again are typical of El Gran Chaco. The majority of them are also found in Asia, while only a few are known from Oceania. In the Table given below some of these cultural elements will be found enumerated. Of the distribution of the most important ones particulars are given in Appendix I.

Tab. 1.

Culture elements occuring in N. America and in southern and south-western S. America, that in intervening regions only occur sporadically, if at all.

	N. A. north of Mexico	Central America	Peru, Inca empire	West Indies	Amazon region	Eastern Brazil	El Gran Chaco and adjacent territories	Patagonia	Araucanian	Tierra del Fuego and adjacent territories	
Sweating-houses	+	+	—	—	—	—	+	—	—	—	See Appendix.
Pit-dwellings	+	—	+	—	—	—	+	—	—	—	»
Plankbuilt-houses	+	—	—	—	—	—	—	—	+	—	»
Tents of animal skins	+	—	—	—	—	—	—	+	—	+	»
Houses with porch	+	—	—	—	—	—	+	—	—	—	»
Arrows with more than two feathers	+	—	—	—	+	—	+	+	?	—	»
Arrows with the feathers fixed with glue	+	—	—	—	—	—	+	?	?	—	»
Arrow-points of stone	+	+	+	+	+	+	—	+	+	+	Linné (2).
Large harpoon-points of bone	+	—	—	—	—	—	—	+	?	+	See Appendix.
Bolas	+	—	+	—	—	+	+	+	+	+	Nordenskiöld (1) p. 45; Friederici (6) p. 34.
Leather armour	+	—	+	—	—	—	+	+	+	—	See Appendix.
Rod armour	+	—	?	—	—	—	—	—	+	—	Krickeberg (1); Spier p. 257.
Wedge	+	—	+	—	—	—	—	—	?	+	Birket-Smith II, p. 187.
Rectangular stone knife	+	+	+	—	+	—	+	—	—	—	G. M.
Fire-making with pyrites and flint	+	—	—	—	—	—	—	—	—	+	See Appendix.
Water-boiling with heated stones	+	—	—	—	—	—	—	—	—	+	»
Pit-ovens	+	—	—	—	—	+	+	—	+	—	Nordenskiöld (1) map 8; Friederici (5).
Tubular smoking-pipes	+	—	+	—	+	+	+	—	—	—	Stahl.
"Monitor" smoking-pipes	+	—	—	—	—	—	+	+	+	—	See Appendix.
Fur-cloaks	+	—	—	—	—	—	+	+	?	+	Nordenskiöld (1), map 15.
		3	7	1	4	4	12	8	7	8	

	N. A. north of Mexico	Central America	Peru, Inca empire	West Indies	Amazon region	Eastern Brazil	El Gran Chaco and adjacent territories	Patagonia	Araucanian	Tierra del Fuego and adjacent territories	
Embroidery on leather	+	—	—	—	—	—	+	—	—	—	See Appendix.
Loin-wraps of tanned deer-skins	+	—	—	—	—	—	+	—	—	—	»
Moccasins or slippers	+	—	+	—	—	—	+	—	—	+	»
Sandals	+	+	+	—	+	+	+	—	—	—	Nordenskiöld (1), map 17.
Shoe-hay	+	—	—	—	—	—	—	—	—	+	See Appendix.
Leggings	+	—	—	—	—	—	+	—	—	—	»
Fringed leather	+	—	—	—	—	—	+	—	—	—	»
Painted skin-cloaks	+	—	—	—	—	—	+	+	?	—	G. M.
Hairbrushes	+	—	—	—	—	—	+	+	+	—	See Appendix.
Combs carved in one piece	+	—	—	—	—	—	+	—	—	+	»
False hair	+	—	+	—	—	—	+	+	—	—	G. M. ; Musters p. 169.
Seamless bags	+	—	—	—	—	—	+	—	+	—	Birket-Smith II p. 138.
Edge-seamed bags	+	—	—	—	—	—	+	+	+	+	» » p. 139.
Bags of bird-feet	+	—	—	—	—	—	+	—	+	+	» » p. 139.
Plank-sewn boats	+	—	—	—	—	—	—	—	+	+	See Appendix.
All paddles crotchless	+	—	?	—	+[1]	—	+	—	+	+	Nordenskiöld (3), map 23.
Double-paddle	+	—	+	—	—	+[2]	+	—	—	—	See Appendix.
Games similar to hockey	+	—	—	—	—	—	+	—	+	—	»
Racket	+	—	—	—	—	—	+	—	—	—	»
Ring-and-pin game	+	—	—	—	—	—	+	—	—	—	»
Games of chance with dice	+	+	+	—	—	—	+	+	+	—	Nordenskiöld (1), map. 27.
Rattles of rawhide	+	—	—	—	—	—	—	+	—	—	See Appendix.
Tortoise-shell rattles	+	—	—	—	—	—	+	—	—	—	»
Dancing with deer hoof-rattles at the ceremonies connected with girls' reaching nubile age	+	—	—	—	—	—	—	—	—	—	» ; Kroeber, Hand-

	N. A. north of Mexico	Central America	Peru, Inca empire	West Indies	Amazon region	Eastern Brazil	El Gran Chaco and adjacent territories	Patagonia	Araucanian	Tierra del Fuego and adjacent territories	
Signalling with smoke	+	—	+	—	—	—	+	+	+	—	See Appendix.
Baskets with feathers or tufts of wool woven in	+	—	—	—	—	—	—	+[1]	—	—	[1]) Huanacache (Mendoza), Métraux (4).
Hair-net	+	?	+	—	+	+	+	—	—	—	Nordenskiöld (1) p. 128; Kroeber (1), Pl. 55.
Baskets water-proofed with pitch or wax	+	—	—	—	+	—	+	—	—	—	Linné (1) map 2.
Scalping	+	—	—	—	+	—	+	—	—	—	See Appendix.
Back-scratcher	+	—	—	—	—	—	—	—	—	+	Birket-Smith II, p. 187.
Sucking-tube	+	—	—	—	—	—	—	—	—	+	» » p. 143.
Pemmican + fish pounded to meal	+	—	—	—	—	+	+	—	—	—	Métraux (2) p. 111.
Ladder-like baby-carrier	+	—	+	—	—	—	—	+	+	+	See Appendix.
Digging-stick with projection for the foot	+	/	+	—	—	—	—	—	—	—	Poma de Ayala.
Digging-stick with stone weight...	+	—	+	—	—	—	—	—	+	—	See Appendix.
Rafts of rushes	+	—	+	—	—	—	—	+	—	—	Métraux (4), p. 36.
Spangling on cloth or leather.....	+	—	+	—	—	—	+	—	—	—	See Appendix.
Skin-quivers	+	—	+	—	—	—	—	?	+	+	» ; Birket-Smith II. p. 151.
Twined-basketry	+	—	+	—	+	—	+[1]	+	—	—	Métraux (4) carte 2.
Carrying-basket (Pisagua type) ...	+	—	+		+	—			—	—	Uhle (3) p. 33.
Bark buckets	+	—	—	—	—	—	—	—	—	+	See Appendix.
Water-carrying in leather bags...	+	—	—	—	—	—	—	+	—	+	»
Coiled basketry	+	+	+	—	×	—	+	—	+	+	»
Stone-headed dagger or knife	+	+	—	—	—	—	—	+	?	+	Outes (1) p. 362; Cooper (1) p. 207.
		4	16		7	4	29	13	13	15	

The reason why in the farthest southern and south-western parts of South America there occur so many culture elements which are also found in North America north of Mexico but not in intermediate regions, must be sought in extensive migrations or independent inventions, but not in culture loans from tribe to tribe. A large proportion of the culture elements mentioned in the Table I. never could have been passed on from one tribe to another in a tropical or sub-tropical region, but only preserved there by peoples that conservatively adherered to their ancient culture, and to whom the tropics were regions which they traversed in a comparatively short period of time.

The occurrence of so great a number of culture elements both in southern and south-western South America and in North America north of Mexico cannot either be explained as being nothing beyond adjustments to similar environments, for the similarities are too abundant and too complex. It is moreover to be noted that many cultural elements of this specific distribution are independent of natural environment, such as the sucking tube, back-scratcher, stone-boiling, ladder-like baby-carrier, etc.

If we supposed that the Indian tribes that now are inhabiting the extreme south of South America, during their migration from north to south tarried for so many generations in the tropics that they then completely adjusted themselves to their environment, and subsequently moved into sub-arctic regions, again adjusting themselves to environment, this ought not to have resulted in a culture of but little originality, and one which for the most part would also be found in North America. It is when emigrants find themselves in altogether novel surroundings, when they encounter a world of plants and animals totally unfamiliar to them, that we may expect to observe the highest degree of originality. Such is in fact the case in tropical America, a region which, like the southernmost portion of South America, in all probablility has received its population in the form of

tribes migrating from North America, where once they lived in a temperate or sub-arctic climate.

The circumstance, that in the extreme southern and south-western portion of South America Indian cultures are found with many traits in common with those of the North American Indians, is thus not only to be explained by the presence of some very ancient cultural stratum eventually forced down to these regions by other peoples, but by the fact that only in the extreme south and south-west of South America did the immigrating Indians meet with cultural conditions of such nature that they found most of their ancient stock of culture elements of practical value in their struggle for existence and therefore preserved them. In tropical primeval forests they could not wear skin clothing, nor find stones for their arrow-heads, and so on.

To these migrations is probably due the introduction into South America, apart from the culture elements above mentioned, of a large number of culture elements very extensively distributed over both American continents, such as the dog, fire-drilling apparatus of wooden sticks, the digging-stick, bone awl, ball games, bee-hive huts, simple snares, ear-plugs or ear-disks, tembeta, the Mataco whistle, the spear-thrower, bow and arrow in general, clump-headed arrow (bird arrow), spear, harpoon, harpoon arrow, "hache simple néolitique" and "hache à gorge", fishing nets, and so on. These culture elements now belong both to hunters and fishermen as well as to agriculturists. They are, as already said, characterized by their wide distribution, and by the circumstance that nothing in the way of physical conditions precludes their having entered America, from Asia, via Bering Strait, nor is there anything to prevent their practical use under widely divergent climatic conditions in America.

At the present stage of scientific research it is not yet possible to determine exactly which of the above mentioned culture elements belonged to any particular tribe of the immigrated peoples.

The majority of the tribes that from North America immigrated into Central and South America settled in regions which presented to them entirely foreign physical conditions, in contact with which they lost by far most of their original culture which was adjusted to entirely different surroundings. I am therefore of the opinion that such Indian tribes as inhabit tropical and sub-tropical regions of South America also originally entered by way of Central America, and possibly the Antilles, into South America, although the actual proof of it is nowadays exceedingly difficult to produce. As we shall see from the following, it is extremely improbable that the Indian tribes that inhabit the tropical or sub-tropical portions of South America have arrived there directly by way of the ocean.

In the tropical region of eastern South America we find sporadic occurrences of culture elements which appear to be relics of the earliest migrations out of North America. Among them are stone-tipped arrows, sandals, watertight baskets, crotchless paddles, carrying-nets, pit-ovens, tubular pipes, arrows with more than two feathers, coiled and twined basketry, pemmican, platform-beds, etc. These have in most places been replaced by something better or more suitable to local conditions. Watertight baskets have been supplanted by clay vessels, the carrying-net ousted by the carrying-basket, the crotchless paddle by its crotched counterpart, the platform-bed by the hammock, and so on. Where no suitable stone material for arrow-heads was at hand, these were made from bamboo or wood. That stone arrow-heads were in fairly wide-spread use in the Amazonas in ancient times is revealed by archaeology. Whence the ideas to these "improvements" arose is of course an immensely important question.

The culture elements just referred to, which are widely distributed in western and southern South America, and in the remainder of that continent only occur sporadically, are in the first-mentioned regions found mostly among such

tribes as the Guayaqui, Siriono, Botocudos, Maku, and others. Generally speaking, they are entirely defunct among peoples of a higher culture.

There have apparently taken place several — perhaps many — migrations from North to South America, both such as we are able to trace among, e.g., the low-cultured Fuegians, and others that do not extend so far south. The earliest migrations must, as I have remarked, date back to an exceedingly remote antiquity.

The first migrants from North America into South America were unacquainted with agriculture, metals, ceramics, and stone celts. Weaving they did not know. They probably possessed coiled basketry, clothing made of skins, watercraft of some sort, although not the dug-out. Some of them had bows and arrows, others possibly not. Their arrows were, at any rate to some extent, pointed with stone.

Other peoples of a more developed culture must have followed upon the first, and it is probable that these migrations from North into South America took place during very extended spaces of time. As I have already mentioned, science is at its present stage unable to prove these migrations linguistically; this inability being probably connected with the fact that the languages have thoroughly so differentiated during the length of time that has elapsed.

One has the impression that those who followed the primary immigrants still were in the stage of gleaners, or small and rude cultivators, and that the agricultural peoples belong to a migration of a later date. It is possible that the former were of a long-headed, and the latter of a short-headed, race. The fact must not be disregarded that in South America there are Indian tribes whose possibilities for development have varied very sharply. This would seem proved by the fact that we find tribes living in adjacent territories and under identical physical conditions, but nevertheless in widely divergent cultural stages.

We have no knowledge of the extent to which certain cultivated plants, already through the agency of these migrations, may have been introduced into South America from Central and North America, all the more as we do not know where in America to locate the origin of many American cultivable plants.

It would be extremely interesting to know when these migrations ceased, leaving the Indians of South America comparatively isolated from those of Central and North America. On this point we are unable to pronounce anything further than that they appear not to have continued subsequent to the time when Indians of Mexico and Central America had developed a really high Indian culture.

After the cessation of these migrations it was the ideas, not the Indian tribes, that crossed the Isthmus of Panama.

It would seem as if those Indians of North America who inhabit the arctic and temperate regions, after the migrations to South America came to an end, have had a fairly considerable access to the culture from Asia. Thereto may be added some few inventions which appear to have originated among North American Indians. Culture elements found in North America but not in South America include, inter alia, "tailor-made" clothes, gloves, a weaver's loom in which the warp consists of down-hanging threads unconnected at the ends, the weaving being done from the top downwards, tipi,[1] cache, sinew-backed bow, compound bow, two-handed scraper, arrow-straightener, bow-cover, harpoon with bladder, toboggan, sledge, travois, the dog as a draught animal, annular stone-boring, double-ball, guessing-game and some other games,[2] seed-beater, basket-hopper, cooking-pots to hang over the fire, foot-drum, quill-work, houses with a smoke-outlet in the middle of the roof, netting-needle, banner-stones, etc.

[1] Tents are mentioned from Atahuallpa's camp at Cajamarca, but nothing is known of their appearance.

[2] *Culin*, p. 647.

A proportion of the above may have been known to the peoples that migrated to South America, though subsequently lost, and possibly some of them occurred in North America only in regions out of which no emigration took place. Some may have been invented later by the North American Indians themselves.

I have mentioned that in the Amazonas certain ancient culture elements have been replaced by others, by way of improvement. This, as I have also said, has in part been proved to have been effected through inventions connected with the adjustment to new surroundings. We are able to observe how the Indians of the Amazonas have improved upon inventions indisputably their own and made in the Amazonas, such as, e.g., the manioc grater and the manioc press. Further, how they have replaced the clyster tube with the enema syringe, and so on. Why might they not have hit upon inventions that also have been made in other parts of the world under similar conditions? Why should they not have been able to improve upon, or — more correctly expressed — adjust to environment the culture elements that they had brought with them from North America into South America? It is illogical to suppose anything to the contrary, but at the same time, as we shall see in the following, it is not right to deny off-hand the possibility that the impulses to such progress and improvement, to a greater or less extent, have been imported into South America from Oceania. What I have most immediately in mind in this connection is, e.g., such an improvement as fitting paddles with a crotched handle. It is of this much-disputed Oceanic influence that I now propose to speak.

But first of all I wish to make it clear that by this time I have become very sceptical of Indian culture having been appreciably influenced from Oceania, although I shall endeavour to discuss the problem as objectively as possible.

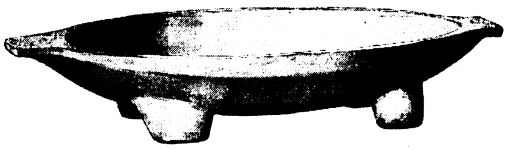

Fig. 1. Four-footed wooden tray. Chocó. Panama. 1/4. G. M. 27.27.164.

"Oceanian" culture elements in South America.

Up till now I have proceeded on the assumption that South America has received its population from North America, that the immigrating peoples brought with them a great deal of knowledge and also made a good many discoveries and inventions in their new country and that they in a more or less excellent manner adjusted themselves to local environments. But as I have said, we must also discuss the possibility of immigrations or cultural influence received directly from across the ocean to the west. Of communication in the pre-Columbian era between South America and the Old world in the east there is not a trace of probability.

As is well known, we find in South America quite a number of culture elements of which parallels are found in Oceania.[1] *These we may call "Oceanian", although this certainly does not imply any proof that they have been imported into America from Oceania.* These "Oceanian" culture elements may derive their origin from the crew of some weather-driven vessel, because the possibility of such having landed upon the coasts of America is not entirely to be disregarded, as Friederici has fairly convincingly shown. Some of them may also originate directly from actual immigrations of exceedingly remote date into South America from across the ocean. Or, with one or two exceptions, these culture elements may simply have been independently invented both in America and in the Old World.

[1] See especially the works of *Rivet, Friederici, Graebner, Pater Schmidt* and *Imbelloni*.

Tab. II.

"Oceanian" culture elements in South America.

	Colombia and Panama	Peru, Inca empire	Central America and Mexico	N. A. north of Mexico	Amazon region	West Indies	Rio Xingú (upper)	Eastern Brazil	El Gran Chaco and adjacent territories	Tierra del Fuego and adjacent territories	Melanesia	Polynesia	
Pile-building	+	—	+	+	+	+	—	+	+	—	+	+	Nordenskiöld (1), (map 1).
Roof-apex cap of clay	+	—	+	—	—	—	—	—	—	—	+	—	Appendix.
Palisades	+	—	+	+	+	—	—	—	+	+	+	+	N (13).
Wooden pillow	+	—	+	—	—	—	—	—	—	—	+	+	Oviedo, T. IV, p. 109.
Wooden seat	+	+	+	+	+	+	+	+	+	—	+	+	P. Schmidt (1).
The calabash (Lagenaria vulgaris).	+	+	+	—	+	?	+	+	+	—	+	+	
The coco-nut palm	+	—	—	—	—	—	—	—	—	—	+	+	Friederici (7).
Irrigation	+	+	+	+	—	+[1]	—	—	—	—	+	+	[1] Lovén p. 61 and 375.
Maces with star-shaped stone -heads	—	+	+	—	—	—	—	—	—	—	+	—	Rivet-Verneau p. 172. Krickeberg (1) p. 167.
All arrows without feathers	+	—	+	—	—	—	—	—	—	—	+	+	G. M.
Knuckle-duster	—	+	+	—	—	—	—	—	—	—	—	+	Nordenskiöld (1), (map 6); Krickeberg (2).
Bamboo dagger or bone dagger	+	—	+	+	+	—	—	—	+	—	+	+	P. W. Schmidt (1).
Blow-gun	+	+	+	+	+	—	—	—	—	—	+	+	Nordenskiöld (3), map. 7; Friederici (4).
Fish-hook	+	+	+	+	—	+	—	+	—	—	+	+	Nordenskiöld (3), map 10.

"Oceanian" culture elements in South America. Tab. II. (contd.)

	Colombia and Panama	Peru, Inca empire	Central America and Mexico	N. A. north of Mexico	Amazon region	West Indies	Rio Xingú (upper)	Eastern Brazil	El Gran Chaco and adjacent territories	Tierra del Fuego and adjacent territories	Melanesia	Polynesia	
Plaited fan	+	—	?	—	+	?	+	+	—	—	+	+	P. W. Schmidt (1).
Water-boiling in bamboo sections	—	—	—	—	+	—	—	+	—	—	+	+	
Four-footed wooden trays	+	—	—	—	—	—	—	—	—	—	—	+	G. M.
Vevesection bow	+	—	—	—	—	—	—	+	—	—	+	—	Heger.
Trepanning	—	+	+	+	—	—	—	—	—	—	+	+	Wölfel; Guiard.
The use of lime along with coca, tobacco or betel	+	+	—	+	—	—	—	—	—	—	+	—	Friederici (9) p. 461.
Rod or spoon used to extract the lime from the calabash	+	+	—	—	+	—	—	—	—	—	+	—	G. M.
Calabash used for the lime that is chewed with coca leaves or betel	+	+	—	—	+	—	—	—	—	—	+	—	G. M. Friederici (9).
Rain-cloak made from leaves	+a	—	+b	—	—	—	—	—	—	—	+	—	a Popayan, b G. M.
Penis-cover	+	—	—	—	+	—	—	+	—	—	+	—	Nordenskiöld (3), map 19.
Stained teeth	+	+	+	+	+	—	—	—	+	—	+	—	» , Lasch.
Composite comb.	+	+	?	+[1]	+	?	+	—	+	—	+	+	P. W. Schmidt (1).
Bark corset	—	—	—	—	+	—	—	—	—	—	+	—	»
Sail	—	+	+	—	—	—	—	—	—	—	+	+	Friederici (2).
» , square	—	+	+	—	—	—	—	—	—	—	+	—	»
» , triangular	—	+	?	—	—	—	—	—	—	—	+	+	» (Letter from).
Double canoe	—	+	+	—	—	—	—	—	—	—	+	+	Frezier, Thompson p. 88 (after Cogolludo).

	Colombia and Panama	Peru, Inca empire	Central America and Mexico	N. A. north of Mexico	Amazon region	West Indies	Rio Xingú (upper)	Eastern Brazil	El Gran Chaco and adjacent territories	Tierra del Fuego and adjacent territories	Melanesia	Polynesia	
Crotched paddle-handle	+	?	+	+	+	+	+	—	—	—	+	+	Graebner (2).
Stilts	—	—	+	+	+	—	—	—	+	—	+	+	Lindblom (1); (2).
Pan-pipes	+	+	—	—	+	—	+	+	+	—	+	—	Nordenskiöld (2) map 11; v. Hornbostel.
Conch trumpet	+	+	+	+	—	+	—	+	—	—	+	+	G. M. , Handbook II p. 540.
Baton de rythme	—	—	?	—	+	—	—	+	—	—	+	+	Métraux (5).
True signal gong	+	—	—	—	+	—	—	—	—	—	+	—	Nordenskiöld (8) map 5.
Masks	+	+	+	+	+	?	+	+	+	+	+	+[2]	» (2) » 12;
Bark-cloth	+	—	+	+	+	—	—	—	—	—	+	+	» (3) » 30.
Bark-cloth mallet	+	—	+	+	+	—	—	—	—	—	+	+	» (3) » 28.
Baskets of lattice type	+	—	?	+	+	?	+	—	—	—	+	?	» (3) » 27.
Arawak loom	+	—	—	+	+	+	?	+	—	—	+	—	» (2) map 15. Olson.
Quipu	+	+	+	+	+	?	—	—	—	—	?	+	Locke; Nordenskiöld (8).
Shield, square	+	+	+	—	+	—	—	—	—	—	+	—	Nordenskiöld (3) map. 12.
» , round	+	+	+	+	+	—	—	+	—	—	+	—	» (3) » 12.
Fishing with poison	+	?	+	+	+	+	—	—	—	+	+	+	» (2) » 6.
Liana bridge	+	+	+	?	+	—	—	—	—	—	+	—	» (8) » 4.
Sword-formed wooden clubs	+	+	+	+	+	—	+	+	+	—	+	+	P. W. Schmidt.
Broad bracelets of metal, tortoiseshell or sea-shell	+	+	—	+	—	—	—	—	—	—	+	+	Montell (2) p. 79.

[2] Island of Mangareva.

That weather-driven vessels from the islands of Oceania have reached the coasts of America may apparently be gathered from traditions handed down by the Indians themselves. A critical study of these has been drawn up by W. Lehmann. His collection of data referring to the occurrence of negroid elements in America is also extremely interesting.

But in any case we are not here going to discuss the possibility of occasional Melanesians or Polynesians having reached America, but whether such stray immigrants might possibly have been of any importance as regards the origin and development of Indian culture.

In Table II hereto appended are enumerated a number of such elements as might possibly be "Oceanian" because of their occurring both in Oceania and America. Only one or two of these are known from northern Asia and may conceivably have entered the New World from the Old by that route. As to the majority, they must either have arrived in America from across the sea or else be independent inventions made by the Indians of tropical or subtropical America. The greater part of the "Oceanian" elements in America belong to agricultural tribes, and none of them — with the possible exception of the triangular sail — occurred in America exclusively within the area of the Inca dominion. Of the 49 "Oceanian" culture elements that are here enumerated, no less than 38 are found in Colombia and Panama notwithstanding the fact that the archaeology, and in part also the ethnography, of those regions are very little known; but few of these cultural elements occurred at the time of the Discovery in the Greater Antilles or on the upper Xingú. With few exceptions they are alien to the pre-Arawak population of the Amazonas as well as to the Tupi peoples of eastern Brazil. Many of these socalled "Oceanian" elements are of very limited distribution, as, e.g., the earthenware roof-apex cap (fig 2, 3) and the wooden pillow, while others are very widely distributed.

Fig. 2. Some »Oceanian» culture elements in South-America.

1. Four-footed wooden tray, Chocó, Panama. 2. Rain-cloak made of palm leaves, Maya, Guatemala. 3. Roof-apex cap of clay, Chocó, Colombia. 4. Signal gong, Caverre, after Gumilla. 5. Wooden seat, Chocó, Panama. 6. Conch trumpet, Ijca, Colombia. 7. Sword formed wooden club, Amahuaca, Peru. 8. Paddle with crotched handle, Patamona, Guiana. 9. Venesection bow, Cuna, Panama, after Wafer. 10. Calabash used for the lime that is chewed with coca, Ijca, Colombia. 11. Pan-pipe, Yuracáre, Bolivia. 12. Club with star-formed head of stone, Ica, Peru. 13. Basket of lattice type. 14. Bracelets of metal, Coast of Peru. 15. Mask, Banána, Brazil. 16. Baton de rythme, Banána. 17. Bamboo dagger, Parintintin, Brazil. 18. Blowgun, Tucuna, Brazil. 19. Penis-cover, Huari, Brazil. 20. Bark corset, after Hianákoto-Umáua Koch-Grünberg. 21. Composite comb, Choroti, Bolivia. 22. Sail, Lago Titicaca. 23. Bark-cloth mallet, Yuracáre, Bolivia. 24. Stilt, Cavina, Bolivia. 25. Trepanned skull, Peru. 26. Knuckle-duster, Mataco, Argentina. 27. Plaited fan, Pauserna, Brazil.

Masks that occur among the Fuegians must, if at all of Oceanian origin, have been introduced into America in an exceedingly remote past, and their history can have nothing whatever in common with the culture elements that are only found among more high-cultured tribes. The same refers to stone-boiling and the sling, which I have not included in the table, and also to tattooing. The sail was probably known on the Peruvian coast earlier than pottery and weaving, and is therefore very ancient, as is evident from Uhle having found, in a grave of the primitive fishermen population at Arica, a toy vessel fitted with a square sail.[1] In case a culture element like the spear-thrower were Oceanian, this could only apply to a certain part of America. The same may be said of the elbow-handled adze.

It is highly interesting that many of the "Oceanian" culture elements listed in the table occur both in North America north of Mexico and in the Amazonas in South America, and in such a way that in the Amazonas they are highly important and show rich development of form, whilst in North America they are less important and of scant form development. There are also a few non-"Oceanian" culture elements that only occur in south-eastern North America and the Amazonas, such as secondary urnburial and cremation in connection with endocannibalism.[2] A very remarkable Amazonian[3]—Californian[4] distribution is that of the fishing-basket of Cayubaba type (fig. 5). Similar baskets also occur in Indonesia.

It is especially on the north-western coast of North America that Amazon-Oceanian culture elements are found, and if we suppose that, from Oceania, these elements were introduced only into one half of the continent and thence spread to the other half, even this supposition would tend

[1] *Uhle*, (2) p. 49.

[2] *Linné*, (2), Map 14.

[3] *Nordenskiöld* (3), map 11.

[4] *Kroeber* (2), Pl. 33, fig. C. (Pomo).

to imply that Oceanian influence, if any, must have belonged to an exceedingly remote past. Of this category are the crotched paddle, the use of lime along with tobacco, the bark-cloth mallet, basketwork of lattice type, and the Arawak loom.[1]

While very many culture elements that do not occur in North America, are found in South America we find extremely few, if any, Oceanian culture elements in North America that do not also occur in South America. If the Oceanian culture elements were passed on from South to North America to any greater extent, this must have taken place at some very remote time, seeing that the last-mentioned continent presents a poorer variety of these elements. The question simply forces itself upon one whether there might not actually have taken place a re-migration from South to North America before the high civilizations in Central America and Mexico reached their fullest development, and whether through some re-migration of this kind certain Amazonian elements were brought into North America. As none of these culture elements are known from the Basket-makers, such re-migration must either have been of a later date than that particular culture, or not have touched the region where we know it to have prevailed.

If we study the table we shall find that the parallels between the Melanesian and Indian civilizations are of much greater importance than the parallels between the Polynesian and Indian civilizations. As we know, the Oceanian island world extending as far as Easter Island is supposed to have carried a Melanesian aboriginal population, and the question arises whether it may not have been from this source that cultural influence possibly reached the American coast. This would also agree with the circumstance that everything indicates that Oceanian influence upon Indian culture -- if ever there was anything of the kind

[1] *Olson.*

worth mentioning — must pre-eminently have taken place exceedingly far back in time.

If, then, a smaller or greater number of culture elements might have reached America by means of weather-driven vessels, they cannot all possess the same history. If the greater part of them really were Oceanian, it might be inferred that repeatedly, and at widely different times, vessels from Oceania were weather-driven to America and that they landed at points on the western coast very far apart from each other, and further that they must have come from different parts of Oceania. Neither would it be out of the question that the same culture element may have been brought to America more than once by means of weather-driven craft landing at places very far apart. This might explain, e.g., the occurrence of the Arawak loom both in the Amazonas and on the north-western coast of North America which was first shown by Mr. Ronald Olson. It is even conceivable that the same culture element may have been introduced from Oceania into one part of America, while in some other part it was independently invented.

That no actual intercourse of a regular character can have taken place between South America and Oceania since very far back in time — anything corresponding to those "relations commercielles" about which Rivet[1] has written — is, however, obvious as this would have resulted in a substantial exchange of cultivable plants. In this connection Friederici has pointed out that there is much which speaks for the theory of weather-driven Oceanian vessels having reached America but nothing of their returning whence they came, or of Indians sailing westward and reaching any Oceanic island. It is important to note that all islands off the South American coast that cannot be seen from the mainland, such as the Galàpagos, Juan Fernandez, etc., at the time of the discovery of America were uninhabited and, judging from everything, always had been so. *On the*

[1] *Rivet* (4).

Galapagos no trace of any pre-Columbian population has been found.[1]

Universally known in Oceania at the time when the Polynesian and Melanesian islands were first discovered by the whites, were the banana and the sugar cane; plants which, according to de Candolle, Karl v. d. Steinen and the present writer, were unknown to the Indians in pre-Columbian times. When introduced into America by the Europeans they excited, as we know, an exceedingly keen demand on the part of the Indians, and the banana in particular attained in very short time an immense distribution even among a great number of tribes that hitherto had not been in contact with white people. Their not having been imported into America from Oceania cannot therefore be explained on the ground that they did not constitute culture elements for which the Indians felt no demand.

Taro, an article of such importance in Oceania, was unknown in America prior to the days of Columbus. In our days taro is cultivated in the far interior of the forests of Brazil.

Domesticated fowls and pigs were widely distributed over Oceania[2] at the time of the Discovery, but had not reached America in pre-Columbian times. Nevertheless, fowls proved, when introduced by the Europeans into America, a culture

[1] *Friederici* (8) p. 39.

"Angesichts dieser und der im Gegensatz zu ihr stehenden anderen Tatsache, dass westlich der Länge von Rapanui ausnahmlos alle Inseln des Pazifik bevölkert angetroffen wurden, oder sie, wenn sie unbevölkert gefunden wurden, Spuren und Anzeichen aufwiesen, dass sie einmal Menschen getragen hatten (78), ist diese Unberührtheit der küstenfernen amerikanischen Inseln so etwas wie ein Beweis, dass von Amerika aus keine Bevölkerung der Südsee-Inseln ausgegangen ist, dass Handelsverbindung zwischen Amerika und den Inseln der Südsee nicht bestanden hat und dass die M. P. Völkerwanderung nur mit Zufallstreffern einiger verschlagener Boote — deren es im übrigen im Laufe der Zeit nicht gar wenige gewesen sein mögen — den Kontinent von Amerika getroffen haben kann."

[2] *Friederici* (9), p. 146.

element received with great eagerness. The domestic pig, originally introduced by the whites, is nowadays very generally found among a number of Indian tribes. With the Chocó, for example, it is along with the dog their most important domestic animal. It is well known that at any rate the Polynesians in all their voyages of exploration carried with them their cultivable plants so as to be able to propagate them in case they happened upon new territories. Why should they not have done so in a voyage to America?

It is not possible that any communication worth mentioning could have been carried on between America and the Oceanian islands without the introduction of culture elements so highly appreciated by the Indians. Voyages undertaken by Oceanians to America — unless limited to the stranding of a random vessel whose crew had consumed all their provisions, and not equipped themselves for a real long-distance cruise — *would therefore date farther back than the introduction of fowls, bananas and sugar-cane into Oceania.*

There are several other things in Oceania besides certain economic plants and domestic animals that one might expect to find in America if in that continent Oceanian influence had entered to any considerable extent. Tortoiseshell, for example, is a very important raw material for ornaments, and other things, in Oceania. In America, where, e.g., on the Panama coast, tortoises are extensively fished by the Indians, tortoiseshell is not made use of at all, or at the most quite inconsiderably.

Even if it be true that in pre-Columbian times the coco-nut palm existed in a small area on the Pacific side of the Isthmus of Panama[1], the Indians have nevertheless not become acquainted with a single one of the appliances that are used in Oceania for the utilization of the coco-nut palm.

[1] *Friederici* (7).

Canoes with outriggers are unknown in America, and yet they might with advantage be used by the Indians on the Pacific coast.

The absence of these inventions I do not, however, consider of the same importance as the absence of the banana, sugar-cane, and fowls. We know from experience that Indians can be very conservative when there is a question of anything beyond cultivable plants and domestic animals, commodities which we always find most eagerly sought for in proportion to their being helpful, without entailing too much hard work, in the Indians' struggle for existence. It is precisely the cultivable plants and the domestic fowl, just referred to, that shortly after the discovery of America spread with incredible speed from tribe to tribe.[1]

There was in pre-Columbian times at all events one cultivable plant common to Oceania and America, and that was the calabash, Lagenaria vulgaris. To it may possibly be added the coco-nut palm which, as mentioned, may have existed on the Pacific side of the Isthmus of Panama at the time of the Discovery. From researches made by Friederici[2] and Laufer it seems, on the other hand, definitely proved that the sweet potato — long considered common to America and Oceania in pre-Columbian time — spread from America in a westward direction, and that not until the post-Columbian era.

Every sort of knowledge concerning the history of Lagenaria vulgaris in America is therefore of great interest. Should some day the botanists be able to prove, e.g., that there existed different species of Lagenaria in America and in the Old World prior to Columbus, this would sweep away the principal proof of pre-Columbian communication between Oceania and America. I am only mentioning this in order to emphasize the exceedingly

[1] *Nordenskiöld* (5).

[2] (10).

great importance of knowing the history of the Lagenaria plants.

The sensibility of Lagenaria seeds to sea water ought to be investigated in order to ascertain whether it is possible that germinative seeds can have been carried across the ocean in weather-driven fruits. A calabash drifted ashore on the Peruvian coast would certainly have been recovered by the Indians, seeing that Indians generally speaking are keenly interested in anything that is new to them in the way of plants and animals. I have seen a Chocó Indian, one Selimo Huacoriso, eagerly collecting on the beach curiosities such as pieces of coral or the carapace of a turtle. He would certainly also have gathered in any fruit that was new and strange to him. We then happened to be on the Atlantic side of the Isthmus of Panama, while so far he only knew the Pacific side. It may be supposed that men of Selimo's type have existed in all ages.

It appears from Tello's exceedingly interesting excavations at Paracas[1] that objects manufactured from the rind of the calabash fruit are there found in the earliest strata, dating farther back than the knowledge of silver and copper on the Peruvian coast. Lagenaria was even known to the very primitive fishermen population of Arica, where ancient graves have been studied by Uhle and the well known botanist, Skottsberg.[2] These ancient fishermen had no pottery, and were unacquainted with the art of weaving. Thus it must have been very far back in time that Lagenaria was cultivated in America. Nevertheless it is comparatively lately that Lagenaria became known in North America, where it has not been found in archaeological remains from the

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[1] (1) p. 126.

[2] *Skottsberg*, p. 39. "*Lagenaria* is generally considered to be indigenous only in the old world and to have been introduced to America in post-Columbian time. But calabashes made of *Lagenaria* have been found in many tombs from pre-Columbian times. Uhle reports them from the aboriginal time of Arica. . ."

Basket-makers.[1] Neither was Lagenaria found in the Antilles before the time of Columbus.[2]

Of Lagenaria the Indians formerly manufactured, and still manufacture, a great number of household utensils and other things, among which may especially be noted the containers that formerly were used on the Peruvian coast, and are to this day used in Colombia and eastern Peru, as receptacles for the lime that is chewed with coca leaves. A corresponding use for calabashes is found in Melanesia, where they are used as lime containers by betel chewers. Both in America and Melanesia the lime is extracted from the calabash bottle by means of a rod or spoon which frequently also does service as a stopper. The calabash rattle is also an important object which in America is very largely made from Lagenaria. According to C. Sachs[3], it is in Oceania found only in Hawaii, where however it is probably post-Columbian.

If it be actually proved that Lagenaria seeds must have reached South America from some Oceanian island, e.g. along with some weather-driven ship's crew, it is of course not unreasonable to suppose that the Indians may have learnt other things from the same quarter. Some few

[1] "As to gourds in the Southwest, I believe that they are not of great antiquity. The small, wild gourd, *Cucurbita pepo*, is native to the region and occurs from Basket Maker times on, but the hard shelled gourd, which I suppose is the *Lagenaria* used for containers, has not, as far as I know, occurred in the region under archaeological conditions save at Pecos, where I recovered part of one from a probably seventeenth century stratum I have always thought that the gourd probably did not work north until fairly late times, and that its introduction drove out the pottery ladle, which disappears at the close of Pueblo III (in other words, about 1300). Had gourds been present in very ancient times, it would seem certain that we should have found them in the dry deposits of Cliff Houses." Letter from dr. *A. V. Kidder* to the author, December 27, 1930.

[2] *Lovén*, p. 383. "Für die *Tainos* will ich nur feststellen, dass es in der älteren Literatur *keinen* Beweis dafür gibt, dass die Tainos Lagenaria hatten, *sondern nur hibuero oder cujete.*"

[3] p. 28.

"Oceanian" culture elements might thus with a certain degree of probability have arrived in America simultaneously with Lagenaria.

A culture element of this category may be the pan-pipe, which by many writers is considered to have been imported from Oceania. The pan-pipe occurs with the earlier ceramics in Nasca, and then in a highly developed form. Its variations as to form among different South American tribes has since become very considerable. The pan-pipe did not, however, at the time of the Discovery occur in Central or North America, or in the Antilles. To suppose, like Jijón y Caamaño,[1] that the pan-pipe came from the north into South America seems to me absurd. This would postulate that it had entirely fallen into disuse in Mexico and Central America while at the same time being much sought after in South America.[2] *Whether the pan-pipe possesses great antiquity in Oceania we do not know; but upon this naturally depends the possibility of its having been introduced from there into America. Rightly or wrongly it is always assumed that the "Oceanian" culture elements are of greater antiquity in Oceania than in America. I cannot see why this should be taken for granted.*[3]

Trepanning is another very important culture element which is considered "Oceanian" in America. It is known

[1] p. 155.

[2] From the Peruvian coast, whence we possess archaeological objects dating from various periods, we hardly know a single culture element of importance which is found in earlier strata but not in later. The only thing I can think of may possibly be true embalmnig. It seems to me far-fetched to explain why many culture elements may occur in South America and Asia but not in North America by asserting that they have travelled via North America, but there fallen into disuse before the time of Columbus.

[3] On *v. Hornbostel's* comparisons between the absolute pitches in Melanesian and Peruvian pan-pipes I do not wish to pronounce an opinion for the present, as similar comparisons, compiled on the basis of material considerably more extensive than that of v. Hornbostel's, are shortly to be published.

from very ancient Peruvian graves, e.g. from Paracas, where Tello has discovered trepanned skulls in great abundance.[1] It is quite evident that in America trepanning mainly occurred in western South America. As to the age of this custom in Melanesia, whence it is supposed to have most directly reached America, we have no knowledge. From Melanesia we only know it in modern times. It would have to be of an exceedingly great age there, naturally, if imported into America long prior to the time of the Incas. However that may be, from what we do know, the Indians appear to have surpassed their "teachers" in operative skill.

Chewing coca with lime is another of those ancient culture elements in America, which, as already mentioned, has its parallel in Oceania in the use of lime in betel-chewing. A similar practice also occurs in north-western North America, where tobacco is chewed with lime. Blackening of the teeth was, according to Uhle, already known to the primitive fisherman population at Supe on the Peruvian coast, as evidenced by the blackened teeth in the skulls there recovered.

A culture element which, if imported into America from Oceania, must have been of revolutionizing importance, is irrigation. It would be strange, however, if it was imported into America without being accompanied by the Oceanian cultivable plants. Everything points to irrigation having spread in America in conjunction with maize, which is an American cultivable plant. Irrigation is a natural adjustment to the surroundings in which the immigrating agriculturists found themselves on the Peruvian coast and in south-western North America.

A culture element already pointed out by Heger as being "Oceanian" in America is the venesection bow. Its peculiar distribution in America points to a great age. The venesection bow occurred or occurs among the Cunas in the Isthmus of Panama and among some few Gês tribes in east-

[1] 40 % of the skulls.

ern Brazil. It is possibly also found elsewhere although it may have escaped the attention of explorers.

The wooden seat, wooden pillow and wooden bowl with four feet (fig 1) are also culture elements that are found both in America and Oceania. Properly speaking, I am of the opinion that these ought to be looked upon as a single culture element. The Chocó Indians, the only people nowadays using the wooden pillow, also use it, when not too small, as a stool. Their leg-supported wooden bowls, which have a very Oceanian appearance, appear to me as nothing but the stool hollowed out in the middle.

Unfeathered hunting arrows have also here been included among Oceanian parallels. Possibly Lovén's explanation as to the reason why certain Indian tribes use unfeathered arrows is correct. He considers that these Indians formerly propelled their arrows from a spear-thrower and not from a bow, and that, when they passed on to bow and arrow, they kept their bow arrows, like their spear-thrower arrows, devoid of feathers.

Certain culture elements usually considered Oceanian, such as the liana bridge and the signal gong, have probably, as I have endeavoured to show in Part 8 of my "Series", been independently invented in America, as it is possible there to follow their development from very primitive to more advanced forms. It may be that in time to come a similar process will be established as regards the majority of the remaining culture elements.

For the present, however, we see that we must not disregard the possibility of Oceanian impulses having reached America through crews of weather-driven vessels. We have no evidence whatever of any actual immigration into America from Oceania, for, as I have said, no South American language has been proved to be of unquestionably Malayo-Polynesian origin, nor has the greater part of Oceanian cultivable plants and domestic animals been transferred to America in any way similar to their dissemination to the

farthest distant islands of Oceania. We cannot, however, deny the possibility of immigration having taken place so far back in time that science in its present stage is unable to furnish linguistic proof.

Rivet has discovered similarities between the Hoka languages in California and Malayo-Polynesian languages. To this it may be added that it is in a region where exceedingly few cultural parallels between American and Oceanian civilization exist that Rivet has discovered linguistic connection between Indian and Malayo-Polynesian languages. Judging from our experience of the present day Indians of South America, there is nothing in this. Supposing that a part, or some, of the Hoka-speaking tribes were Malayo-Polynesians, or a mixed race of these and Indians, this would not necessarily imply their having a Malayo-Polynesian culture. Our experience tells us that a people which emigrates to a region that is strange to them, and there encounters a people that has throughly adjusted itself to the prevalent surroundings and occupies a similar cultural level, in all probability adopts the culture of the latter, without necessarily also adopting their language. The Chiriguano, for example, conquered the Chané in the 16th century, forced upon them their language, but adopted their culture. In the same way it is highly probable that, if a group of Polynesians or Melanesians, having entered America, settled in a territory inhabited by Indians, they would have become completely Indianized. It is a notable fact that the peoples of the Hokan group are such indifferent sailors. This does not favour the theory of their ancestors being of a Malayo-Polynesian origin.

The presence of Malayo-Polynesian elements in the Hokan languages naturally does not explain the occurrence of Oceanian culture elements in Central and South America, for it would be a great mistake to believe that because it has been linguistically proved that, in places, linguistic connection has existed between Oceania and America, it

is thereby also proved that all common culture elements derive from a common origin. Some of them may be loans, and others independent inventions, both in the Old World and the New. But, on the other hand, if the presence of Malayo-Polynesian languages in South America were established, this would naturally prove that actual immigration had taken place from Oceania, similarly to what must have happened in North America if it is correct that the Hokan languages are of Malayo-Polynesian origin.[1]

Do the higher Indian civilizations of ancient America owe their origin to Asiatic influence?

I will now proceed to discuss the possibility of Asiatic influence directly by way of the Pacific Ocean upon Indian civilization. By "Asiatic" culture elements in this connection I refer to such as are common to some cultures in America and in Asia but absent in Polynesia, Melanesia and Micronesia, and such as are not in the least likely to have reached America via Bering Strait because of their inapplicability to an arctic climate, or such as do not appear to have entered by that avenue as they are unknown in North America north of Mexico as well as in northern Asia.

In the area covering the higher civilizations of Mexico, Central America and western South America there occurred at the time of the Discovery a multiplicity of culture elements that were not found among the more primitive Indian tribes in America. Some of these elements convey an im-

[1] *Rivet* has also pointed out remarkable resemblances between the Tson languages, which are spoken by the Ona and the Tehuelche, and languages found in the Australian continent. As to this, however, I am not competent to pronounce an opinion.

pression of being fairly new in America at the time of the Discovery, as they, although presumably desirable, had not by then had time to spread over more than a small part of the civilized area.

Among these culture elements which we find in South America are metallurgy, comprising, among other things, such important inventions as ore-smelting, metal-casting in the ordinary way, casting à cire perdue, embossing, bronze, gilding, mettre en couleur, etc., highly-finished weavings including ikats and batik, artistic architecture in stone and adobe, pyramids, beam-scales, steelyard, teeth-filling, the mirror (concave and convex), litter, handle-holed axe, parasols as insignia of rank, metal pincers, mosaic work of stones, wooden articles inlaid with lacquer (See Appendix 2), etc.

Let us begin with metallurgy, a subject of outstanding importance. What, inter alia, characterizes Indian metallurgy is, as we know above all from Rivet's highly valuable researches, that *it is not homogeneous*. Casting by the direct method was at the time of the Discovery practised from Argentina and Chile to Mexico, but unknown in eastern North America, where metal objects were shaped by hammering the native metal. Casting à cire perdue was somewhat less distributed than casting by the direct method. Bronze was known all the way from Argentina and Chile as far as Ecuador, and also in Mexico. In Colombia and Central America bronze was unknown, and in the greater part of that region there was no knowledge of copper tools. The people of the Cauca valley possessed tools made of Au-Ag- Cu, which in hardness were quite equal to bronze tools (see Appendix 3). In all parts where at the time of the Discovery the Bronze Age prevailed, that cultural stage — which appears to have originated in the region surrounding Lake Titicaca — had been preceded by a copper age. The people of the Proto-Chimu period in Peru were acquainted with gold, copper and their alloys, and possibly also silver, and knew how to smelt and cast these metals. Tin and

bronze were unknown. The Proto-Nazca people knew no metal besides gold, and the smelting of metals was probably unknown to them.[1] The Indians who were the bearers of the remarkable, and doubtlessly very ancient, civilization known as the Paracas culture were acquainted with gold, but not with silver or copper. Their axes were of stone.[2] It is thus possible to follow, step by step, the development of metallurgy in western South America.

What is then the significance of this? If in any way the different inventions in the field of metallurgy had been transplanted from Asia to America, this must have happened at different times and partly to different parts of America. Thus the Indians of North America must have learnt how to use copper but not how to cast it; other Indians would first have learnt how to cast copper but not bronze, and lastly the Indians on Lake Titicaca in Bolivia would have had to learn how to smelt copper and tin together so as to produce bronze, and subsequently passed on that knowledge to others. All this is simply absurd, as it postulates a continuity of intercourse that now and again would have been interrupted in one direction and carried on in another. If it be supposed that Indian metallurgy owed its origin to Asia, one would expect it to be of a more or less homogeneous character, dependent upon supply of raw material. It is evident that Indian metallurgy is of Indian origin, and that, when America was discovered, the Indians had already made a number of independent inventions in this field, inventions which at that juncture were so recently made that they had not had time to spread over the whole extent of metal-bearing regions. The only thing we cannot be certain has not been imported from Asia is the fundamental idea of using metals at all, and to use them hammered but not cast, as did the Indians of eastern North America at the time of the Discovery, a method

[1] *Kroeber* (1), p. 109.

[2] *Tello* (1), fig. 97.

probably also practised by the South American Indians before they learnt how to smelt and cast metals. In the Antilles the Indians, at the time of the Discovery, had not passed beyond the stage just referred to, in that they did not know how to cast their native gold, but only how to cold-beat it.[1] Guanin, or tumbaga, they obtained from the mainland. Metal tools of the crudest class, like the simple hoe-blade, are also common to North and South America. As regards the American bronze I consider having shown that it was invented somewhere in the neighbourhood of Lake Titicaca and that it subsequently became known throughout the Inca realm and, as I have mentioned was shown by Rivet, also in Mexico.

When we know that the Indians have in all probability independently achieved inventions as difficult as that of bronze, we must also find it highly probable that they have independently invented all the metal tools and metal ornaments that they were using in pre-Columbian times, at all events as far as these objects are not imitations of their stone prototypes of more ancient times. In some few cases, such as the handle-holed axe, the bell and the pincers, we are able directly to demonstrate the manner in which they were invented and to observe typologically their subsequent changes or improvements — if the latter term be preferred.[2] Some are of an original character and without exact counterparts in the Old World. Such as are imitations of stone forms may not necessarily, as I have already remarked, with regard to their form have been invented independently in America, unless the American stone age was untouched by influence from the Old World.

When, archaeologically and typologically, we are able to prove that inventions like bronze, the handle-holed axe and the pincers in all probability have been made independently by the Indians, and when we, moreover, are familiar with

[1] *Lovén*, p. 432.

[2] *Nordenskiöld* (4).

all those discoveries and inventions which were only known to them but unknown in the Old World, then it is surely a mere matter of logical reasoning to suppose that independent inventions may have been made by them in the realms of architecture, the art of weaving, ceramics, etc. What I have here brought forward will thus be seen to speak against any probability of the higher civilizations in America, at any rate after the Indians had learnt to smelt metals, having been influenced from Asia.[1]

The development in other respects of South American Indian civilization during this period also appears untouched by outside influence, and we are therefore justified in supposing that everything new that then came into being was invented by the Indians, at any rate whenever it is a question of parallels to Asiatic culture. It is probably during this period that such a wonderful invention as that of applying the decimal system to the quipus was made, in such a way that the numerals derive their value relatively to the order in which they are placed — that is providing it be correct, as I am informed by Dr. Tello, that quipus of this kind have exclusively been found in Incaic, i. e. later, graves. The simpler

[1] A very important metallurgical invention is that of extracting metal out of the ore. Both in the Old World and the New, man has known and used native copper before he learnt to turn its various ores into account. It is evident that the Indians of Peru, already before they knew bronze, produced their copper out of several different kinds of copper ore. This is clearly apparent from the impurities, arsenic, antimony, bismuth, nickel, etc., which are present in copper articles. An interesting question is this: When did the change from the exclusive use of native copper to the working of copper ores, occur and what was the distribution of the latter art? From Mexico I know of no reference to reduction of copper ore in pre-Columbian times, nor to smelting furnaces like the famous *huayras* of Peru. Dr. W. Krickeberg, the eminent Mexican specialist, has in a letter informed me that neither does he know anything as to ore-smelting in Mexico, nor has he heard of huayra-like furnaces from there. Can it be possible that the Indians of Mexico only knew how to smelt the native metal, and that the tin found in their bronze articles was imported from Peru?

kinds of quipus must be of a far greater antiquity, but their distribution in America is accordingly immensely more widespread. The fundamental idea may be of "Oceanian" origin, but this is out of the question when it comes to applying the decimal system to quipus so as to make numerals assume value according to their sequence of arrangement, which is an entirely original idea.

From the later period of the Incaic era fortifications with saw-toothed walls, like those at Sacsahuaman, appear to date. These must have been independently invented in America[1] where they are only known from the Inca kingdom. During the Incaic era the Indians, as we know, possessed a most wonderful social organization, and their culture may be described as highly advanced.

We should always remember that the higher the development of a civilization is, the greater is the probability that new inventions will be made independently. At a certain stage there will occur acceleration of development, at any rate within certain realms of the culture. In primitive society there is hardly any other division of labour than that between the sexes, or the ages, or between different tribes. In social organizations like that of the Incas, on the other hand, there were artisans, that is to say specialists of various kinds. An individual that chiefly occupies himself with a handicraft as, e. g., a worker in iron, should be more likely to make an invention concerning metallurgy than one to whom the handicraft only constitutes a minor part of his daily struggle for mere existence. There were mighty rulers and a demand for luxury spurring the artisans on to increased efforts. In this social structure the medicine men constituted a guild which, as far as we are able to judge, exclusively engaged in spiritual activities, whereby development no doubt was greatly stimulated.

[1] With regard to these fortifications General *Langlois* and the author are at present engaged in collaborating upon a treatise which is intended for inclusion in my Comparative Ethnographical Studies.

If we admit that in America the metal culture was of independent origin, we have thereby admitted that the Indians have evolved a multiplicity of inventions beyond those which they must have made for the reason that they are only known from America. This lessens the necessity of a number of other parallels having to be explained as being loans from directly across the ocean. One invention is apt to bring another along in its train.

The fact, that during the metal era Indian culture developed independently, does not, however, justify off-hand the assumption that all higher Indian civilization did the same. Not only in Peru, but also in Central America and in Mexico the Indians lived in a high state of culture during the stone age. The copper or bronze ages are not synonyms of an essentially higher civilization in America. It only means that in certain regions the Indians had achieved a considerable measure of progress. The bronze age does not mark the adoption of a new civilization but only an amplification of the copper culture in Peru, and the transition from the stone age to the copper age means nothing more than a further step in development, and not the accession of a new people with a new culture. The earliest Maya inscriptions on immovable objects date from the first centuries A. D., and at that time the wonderful calendar of the Mayas had already been perfected. Then, as very much later, the Mayas were a stone-age people. At Paracas in Peru, Tello has discovered the remains of a civilization in which especially the art of weaving was on a marvellously high level, although no other metal than gold was known[1].

Thus far we have then not proved that the higher Indian civilization, such as we know it from western South America and Central America, was not influenced from Asia; we have only emphasized the probability that no such influence existed during the later period of the copper age or during the bronze age.

[1] *Rebeca Carrion Cachot.*

It is difficult to conceive that the higher civilizations of Central America and South America have derived from a common, *extra-American* primary source, for in that case these civilizations ought not, supposedly, be so fundamentaly different as, e. g., in their architecture. If the Central American and the Peruvian Indians had conformed to the same models in their respective architectures, these ought not to show such radical divergences. Waterman[1] is entirely correct when in his exceedingly interesting exposé of Indian architecture he writes: "It seems to my mind, . . . how one step in architecture follows another and grows out of it. Borrowing from abroad, if it occurred, must have been continuous over thousands of years". Waterman has arrived at the same result regarding architecture as I have regarding metallurgy.

If Central American civilization had arisen, say, through influence from the Old World, and that of Peru were merely its offshoot, one would surely not in Peru find such a large number of "Asiatic" elements which are absent in Central America. If such a common original source exists, then the greater part of the inventions that are known only in one of these regions would be independent inventions or direct loans from the Old World. It cannot very well be supposed that a number of culture elements may have arrived by land from Asia to Peru after the high cultures had already become established in Mexico and Central America, without having left some traces behind. This means that inventions that existed in the Inca kingdom but not in Central America or Mexico either must have been inventions independently made in South America or else have been imported directly from across the ocean. Of any such communication with Asia we have, however, no knowledge nor is there any such probability about this as in the case of Oceania. If there had existed any connection of this kind, it ought to be demonstrable, at any rate

[1] p. 523.

to some extent, that the Asiatic culture elements in South America possess a common origin in Asia, but this is not the case.

Let us now more closely scrutinize a few of the most conspicuous parallels between the higher civilizations of the Old and the New World with especial regard to such of

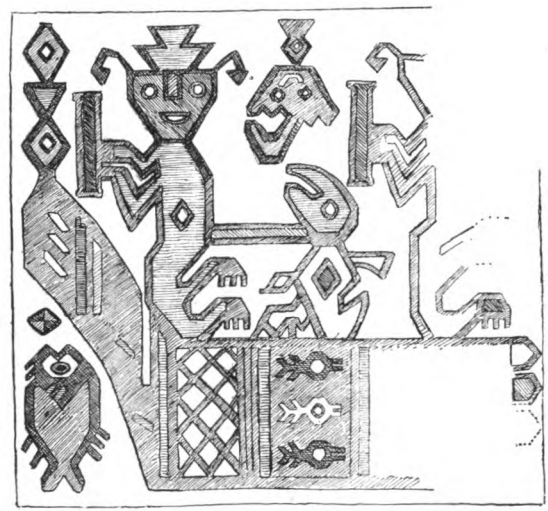

Fig. 3. Peruvian textile probably representing fishing with Cormorants. Pachacamac. $^1/_4$. G. M. 21. 6. 108.

these culture elements as are found in South America. Among these are one or two that do not belong to the higher cultures.

An interesting parallel between Asiatic and American high culture is that in both parasols are used by chiefs as insignia of rank. There is no need for me to cite any instances from Asia as such are found in numberless picture-books on India, etc. It is a subject which moreover has been exhaustively dealt with by Andrée in Part I of his "Ethnografische Parallellen". In the Inca realm the feather parasol was universally adopted as a symbol of rank, as is evident

from the sketches of Poma de Ayala,[1] and from the literature of the era of the Discovery.

Quite astonishing is the similarity which is found — as pointed out by Flinders Petrie and other writers — between the T-shaped axes of stone, copper or bronze of South America and the T-shaped axes of stone, copper, bronze and iron of Egypt. As the T-shaped axe is not known in North America or in northern Asia, the conception of making such tools cannot have entered America from that quarter. For my part, I am of opinion that this is a case of an invention independently made in South America, which probably can be typologically followed from the grooved axe.

A parallel between Chinese and Indian culture is duck-hunting with a calabash. In a place where duck are usually found, calabashes are thrown on the water and left to float about until the duck are used to them. When the duck are no longer afraid of the calabashes, the Indians cover their heads with a sort of mask made from calabash shell, and stalk the duck with only the mask showing above the water. The duck, which have lost their timidity of the empty calabashes, do not fear the hunter concealed in the calabash mask, and allow themselves to be caught with the bare hands.

In America this strange method of hunting is known from Mojos, Maracaibo, Haiti, Chiriqui, and Mexico. Du Halde reports it from China.[2]

[1] *Montell* (2), fig. 99.

[2] *Du Halde*, T. II, p. 164. "Ausser dem zahmen Federvieh haben sie auch eine grosse Menge Flügelwildpret, vornehmlich aber die wilden Enten. Die Art und Weise, wie sie dieselben fangen, verdient angeführt zu werden. Sie stecken den Kopf in grosse ausgehölte und abtrocknete Kürbisse, darinnen Löcher befindlich sind, dass sie sehen und Odem holen können, Darauf gehen sie ins Wasser oder schwimmen vielmehr in demselben, und lassen weiter nicht sehen, als den im Kürbis steckenen Kopf, Die Enten, die dergleichen schwimmender Kürbisse gewohnt sind, als mit welchen sie im Wasser zu spielen pflegen, nähern sich denselben ohne alle Furcht; der Jäger aber kriegt sie sogleich beym Fuss, und damit sie nicht schreyen können, so dreht er ihnen gleich den Hals um, und hängt sie an seinem Gurt."

By way of Behring Sound this hunting method cannot have reached America from China. Another strange hunting method is catching turtles by means of sucking-fish. In America this method is only known from the West Indies, and in the Old World from the coasts bordering on the Indian Ocean.[1]

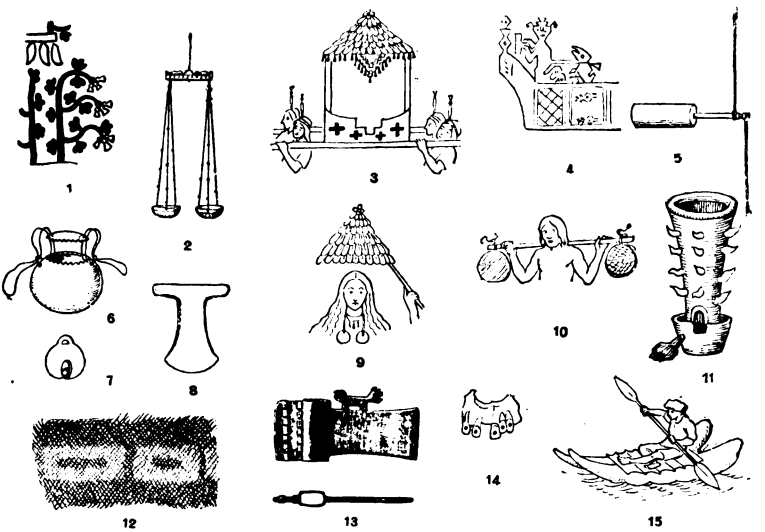

Fig. 4. Some »Asiatic» culture elements in South America.

1. Plant ornament on textile from the Peruvian coast. 2. Beam scale, coast of Peru. 3. Litter, Peru, after Poma de Ayala. 4. Fishing with cormorants, Pachacamac. 5. Steelyard, Quichua. 6. Calabash with star-shaped lid, Ashluslay, Bolivia. 7. Bell of copper, Peru. 8. T-shaped bronze axe, Quiaca, Peru. 9. Parasol as token of rank, Quichua, after Poma de Ayala. 10. Coolie yoke, Cueva, Panama, after Oviedo. 11. Huayra, Quichua, after Barba. 12. Batik, Pachacamac. 13. Handle-holed axe, Trujillo, after Baessler. 14. Teeth filling, Yucatan, after Krickeberg. 15. Double raft made of inflated animal skins, coast of Chile, after Frezier.

Fishing with cormorants, so well known in China, was probably also practised in Peru, if Max Schmidt's deductions are correct.[2] Fig. 3.

[1] *Lovén*, p. 400 (after *Martyr*).

[2] (2), fig. 19.

In swamp regions of California and Amazonas, fishing is done with an appliance shaped like a truncated cone (fig. 5). Exactly similar contrivances are known to me from Indonesia and Africa.

With a Chinese counterpart is the use of the coolie yoke among the Seri and other Mexican tribes, and the Cunas.[1]

Another interesting culture element is the quilted armour. This occurred in pre-Columbian times both in Peru, Yucatan and Mexico.[2] In the Old World it is known from Borneo and northern Africa.

Fig. 5. Fishing basket. Cayubaba Bolivia. $^1/_{12}$. R. M. F. 1.

Ikat[3] and batik, textiles so well known from Indonesia and besides from many districts of the Asiatic Continent, were also known to the Indians of the Peruvian coast. Of all the wonderful things that the ancient Peruvians knew about textile technique, it is especially the ikat and batik methods that have engaged the attention of those who have compared Indian culture with that of the Old World. Why

[1] *Nordenskiöld* (8) . To what I have here said as to the occurrence of the coolie yoke among the Cunas of former days I wish to add, in accordance with what I am informed by the Cuna Indian Ruben Pérez Kantule, that the carrying-pole to this day remains the carrying contrivance of the men. For easy carrying, the rear load has to be a trifle heavier than the front one.

[2] In Yucatan it is supposed to have been imported from Mexico, as the name is a Mexican one. (*J. Eric Thompson*, p 86).

[3] *Snethlage*.

especially ikat and batik should be considered such remarkable inventions I do not quite understand. Dixon[1] quite rightly emphasizes, too, that these textile methods should be studied in connection with negative painting on pottery and calabashes, an art which was widely known in Central and South America.

Exceedingly remarkable parallels between the higher civilizations of the Old World and that of western South America is the occurrence of the beam scale, the steelyard,[2] and weights that are multiples of a unit.[3] It should however be noted that, of the inventions just mentioned, at any rate the beam scale appears to belong to a very late period in South America,[4] and that the Indians employed an absolutely original method for checking the equilibrium of the beam.[5] Pendular checking with the vertical points, which is typical of the Old World, was on the other hand unknown in America.

The uruya, i. e. a rope, along which runs a basket or something similar, stretched across a river, which anciently was, and still is, used in western South America at river crossings, has a parallel in the interior of Asia, e. g. in the Himalayas.[6] Double rafts made of inflated animal skins, known from northern Chile,[7] we find parallels to in western China.[8] Manuring with human excrements, a method which to the Indian tribes east of the Andes not only is unknown but most undoubtedly would be highly offensive and disgusting, was used in Mexico and Peru, as well as in China.

Other parallels between the higher civilizations of the Old World and South America are stamps, concave and convex

[1] p. 201.
[2] *Nordenskiöld* (10).
[3] *Nordenskiöld* (9).
[4] As to this, nothing is however definitely known.
[5] *Max Schmidt* (3) fig. p. 544.
[6] *Haberlandt*, p. 452.
[7] *Frezier*, Pl. XVI. These consist of inflated animal skins.
[8] *Haberlandt*, p. 442.

mirrors, lacquer, teeth-filling, the tipoy, the litter, adobe, true embalming, calabash boxes with star-formed lids (See Appendix 6), games of hazard with a counting board, plant ornaments on fabrics and pottery, etc.

Of cultivable plants beyond those referred to in the foregoing—Lagenaria and, possibly, the coco-nut palm — the ancient American higher civilizations possess none in common with the Old World. This I consider as being a very significant fact. It is true that the cotton bush was common to both, but it was not the same species that in pre-Columbian times were cultivated in the Old World and the New.

A proportion of these "Asiatic" culture elements are probably, as we shall presently see, importations from Central America into South America. Those that are "Asiatic" thus ought to have entered America by way of North or Central America. Others of these culture elements only occur in South America.

Thus we have seen that, apart from metallurgy and architecture, there are a great number of noteworthy parallels between the higher civilizations of America and the Old World, but we also see that those culture elements are not homogeneously distributed in America. In the Old World it is in China, Indonesia, central Asia, the coastlands of the Indian Ocean, and Egypt that we must look for parallel forms to them all, which of course very greatly argues against their having a common origin. It would be quite a different thing if the parallels between American civilization and the Old World both in the New and the Old World were to some extent homogeneously distributed; if, for example, we found them all present in Indonesia, and there of greater antiquity than Hinduan influence.

Consequently the higher civilizations of the New World in Mexico, Central America and Peru, do not in any way appear to be cultural dependencies of any special part of the Old World.

As I have already pointed out, certain of the culture ele-

ments that are common to the higher American civilization and the higher civilization of the Old World appeared in America at a comparatively late date, as, e. g., bronze. On the other hand, many "Asiatic" elements, e. g. embalming, are very ancient in America. True embalming with preservative oils has thus been shown to have been practised in America among the ancient fisherman population of Arica,[1] while so-called "mummies", of the same locality but of a later period, are nothing but dessicated corpses. With regard to a proportion of the later Asiatic culture elements in America, such as bronze and the handle-holed axe, I believe to have proved that they were independently invented in the New World. We have many reasons for classifying the remainder of the elements in the same category, principally because no cultivable plants, apart from those referred to in connection with "Oceanian" parallels, are common to both Worlds.

Besides the above mentioned plants and domesticated animals, there were widely distributed in the Old World a number of essentially important culture elements of great antiquity, which were unknown in pre-Columbian America, such as the vehicular wheel, the true potter's wheel, the bellows, true glazing, kiln-baked bricks, all stringed musical instruments, with the possible exception of the musical bow, the handmill provided with a turning handle, the true mason's arch, and the agricultural rake.

At the present stage of scientific research we may thus assume that the ancient high civilization in America developed independently of any Asiatic influence directly from across the ocean, and that this higher American civilization cannot either derive its origin from immigration, via Bering Sound, of tribes superior in culture to the rest of the peoples in America. *Evidently all higher civilization in America in the main constitutes an intensive development of Indian culture under favourable conditions.* Western South America does indeed offer highly favourable conditions. There are

[1] *Bodman.*

present potentialities for intensive agriculture providing for an abundant supply of food, as well as space for a dense population. On the high plateau surrounding Lake Titicaca there are excellent grazing grounds, and animals suitable for domestication were also at hand. Such a valuable metal as copper was of common occurrence on the ground surface, even native, and in large and easily worked chunks. What was needed for the Indians to develop a higher civilization was the discovery of such cultivable plants as could provide an abundant supply of food supply all the year round, and those they found in maize and potatoes — vegetables of indubitable Indian origin.

Thus we have seen that agricultural civilization in America is mainly indigenous, that is to say that the cultivated plants, with one or two exceptions, are American. We have further seen that the metal culture in America, at all events since metal-casting came into being, is indigenous. From Oceania the Indians have received one or two cultivable plants, and possibly a few more culture elements. Even if Oceanian influence might be greater than I am inclined to think, Indian culture is nevertheless essentially American.

One exceedingly important invention to which I have not made any reference whatever in the foregoing is ceramics. This is a field in which the American Indians have excelled more than anywhere else. If we compare, e. g., the ceramic collections from various parts of the world that are contained in an ethnographical museum, we shall find that an overwhelming proportion of the pottery forms are also known in America. And, as we know, the cream of Indian art consists of ceramics. The earliest immigrants into South America apparently did not know ceramics. They possessed pit ovens, stone-boiling, watertight baskets, and other things, but no pottery. From Oceania the Indians may have learnt how to manufacture crude clay vessels, but by far the greater part of the inventions relating to pottery that are found in America are not known from Oceania,

nor even from Indonesia. Neither do we know anything as to the relative age of Oceanian and Indian ceramics. Via Bering Sound the Indians might conceivably have learnt how to make crude and inferior vessels of burnt clay, but nothing further.[1] That the Indians received any cultural impulses from the higher Asiatic civilization directly across the ocean is, as we have seen, extremely improbable, and this is consequently also applicable to ceramics. In addition to this it should be noted that Indian ceramic art possesses so little in common with the ceramics of the Asiatic civilizations because the Indians were unacquainted with the true potter's wheel. If all the different inventions relating to pottery had been imported into America from Asia it would mean that continuous communication had been maintained between the New World and the Old, and thereby gradually — seeing that in America pottery was improved only gradually — had been transferred one invention after the other from the Old World to different parts of the New.

An invention of comparative lateness is, e. g., painting of pottery prior to baking. The American Indians had attained to a highly developed ceramic art before they became acquainted with this invention.

In northern Argentina and southern Bolivia, incised ceramics, which in those regions were partly of a very high quality, appear to have been more ancient than painted pottery. When the Arawaks emigrated to the Greater Antilles they were unacquainted with the art of painting pottery before baking. It is evident that a great many other inventions have been made relating to ceramics after this method had come into practice, such as tripod ceramics, lids, moulding of vessels or parts of vessels, pot-handles of the usual type, etc.

There is much that favours the assumption that the American Indians invented their ceramics exclusively out

[1] See *Linné* (2), p. 271.

of their own conception, and in Part 8 of my "Series" I think that I have shown how this *may* have been done. As to the date of this happening, or whether this invention was made only once or several times, are matters beyond our knowledge.

In America, the art of ceramics, as above all Spinden has pointed out, has always excelled where maize culture was on a high level. Even in the Amazonas we find, on Rio Tapajoz, the most remarcable pottery among peoples that first and foremost were cultivators of maize. Maize culture is probably more ancient than the art of pottery-making. The Basket-makers, for example, possessed maize, but had no pottery.

Of extreme importance would be a thorough botanical examination of the remains of cultivated plants such as the sweet potato that Tello has discovered from the earliest higher civilization known on the Peruvian coast, viz. that of Paracas. There, as among the Basket-makers, only one variety of maize was known. There were furthermore two varieties of bean, viz. frijoles (Phaseolus vulgaris L.) and pallares (Phaseolus pallar Molina), and mandioca. The maize cobs were small, dark-brown or black, frijoles small and black, and pallares white with mulberry-coloured spots. The mandioca roots and the sweet potato tubers were small and twisted, contrary to the large tubers of these plants that have been found in later graves. From this we note that also the sweet potato was cultivated in America in far distant times, and yet there is much that goes to show that in vast regions east of the Andes its cultivation began at a later date than that of maize and cassava.

If maize, as is generally supposed, originally came from Mexico, we must imagine to ourselves a South American agricultural civilization devoid of maize. We have, it should be noted, no evidence whatever to prove that maize is the most ancient of the plants that were cultivated in America.

Its cultivation appears to me as postulating a much more advanced civilization than the cultivation of certain roots, etc., which it had been customary to collect in their wild state before any agricultural enterprise had even begun.

Without the cultivation of maize the Peruvian coastland can hardly be conceived as having carried a considerable population or any higher culture. Under similar conditions it is possible that, e. g., the Amazonas, if mandioca was known there before maize, possessed a highly developed Indian civilization earlier than the Peruvian coastland. This is at all events a possibility to be reckoned with.

There is some degree of probability, therefore, that Rivet[1] is partly correct when he opines that the Peruvian coast civilization received its principal cultural impulses from the east. His point of view appears to me at any rate well worth considering. For my part I am above all inclined to seek the origin of those Amazonian culture elements in north-western South America. Rivet assumes that there have been several waves of Amazonian immigration into western South America, and is of the opinion that thereby were introduced, among other things, the pan-pipe, head ornaments, the blow-gun, the T-shaped axe, and "la hache à encoche". It is also an interesting point that the hammock and the wooden seat, two exceedingly important culture elements in the Amazonas, were used in Peru only as insignia of rank, a fact which points to their being relics of an earlier civilization. This does not, however, exclude that the Amazonian tribes in later times learnt a good many things from the west, not least as regards the art of pottery-making.

On the Andean highlands conditions were also favourable to the rise and development of a rich Indian civilization without maize cultivation. There the Indians were able to cultivate potatoes, oka, quinua,[2] and other plants, etc.

[1] (6).

[2] In a grave dating from the primitive fisherman population at Arica, *Uhle* recovered a bag of white wool containing 5 kilogrammes of quinua

Probably they also did very well with their hunting. Further, they domesticated the guanaco and the alpaca. All this constituted an excellent source of wealth. Therefore, before the Peruvian coast acquired a higher Indian civilization, we might picture to ourselves two earlier culture centres in western South America, viz. one around Lake Titicaca and another in north-western South America. This is at all events a possibility we have to reckon with. In the area covering the higher civilization in the Andes we find that there is a great deal that has survived of the culture to which there are parallels in North America. In north-western South America there are many parallels with the Amazonas.

Cultural interchange between the higher civilizations of Central and South America.

In the foregoing I have emphasized that no important migrations from North or Central America to South America have taken place in times so recent that they can be proved by the tracing of any North or Central American language in South America. Ideas, on the other hand, have travelled, which signifies loans of separate culture elements but not assimilation of culture.

Before we study this cultural interchange between the Central American and South American Indians, we ought, perhaps, to make a brief survey of the outstanding divergencies of the civilizations of these two great American culture areas. Among Peruvian culture elements that, so far as our knowledge goes, were unknown to the Mayas, Aztecs, and other Mexicano-Central American peoples, we note,

seeds, proving communication between the coast and the high plateau. The Indians of the highlands already at that time cultivated quinua and were weavers of wool. (Desarollo, p. 37).

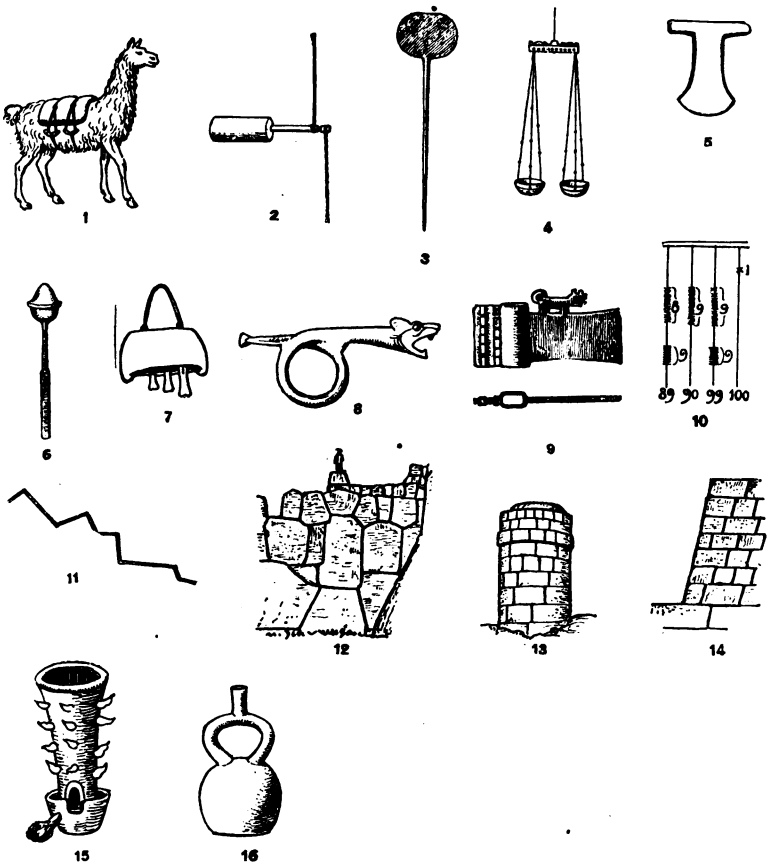

Fig. 6. Some Peruvian culture elements that, so far as our knowledge goes, were unknown to the Mayas, Aztecs and other Mexicano-Central American peoples.

1. Llama. 2. Steelyard. 3. Topu. 4. Beam scale. 5. T-shaped axe of metal. 6. Rattle of copper pieces *welded* together. 7. Bell with clappers. 8. Earthenware trumpet with bent-over tube. 9. Axe-head of metal holed for the haft. 10. Quipu with the knots arranged after the decimal system. 11. Fortifications with saw-toothed walls. 12. Walls built of stones of gigantic dimensions and extremely well joined together. 13. Circular chulpas. 14. Walls built of truly alternating stones. 15. Huayra. 16. Vessel with »stirrup» handle.

among others, the llama, guinea-pig, musk-duck, potatoes, coca, quinua, oka, Ullucus tuberosus, Tropaeolum tuberosum, arracacha (Conium moscatum), the steelyard and the beam scale, sculptured rock faces (à la Samaipata), uruya, T-shaped axe of metal, axe of metal holed for the haft, spiked war club of metal, topu, bell with clappers, earthenware trumpet with bent-over tube, reduction of copper ore, copper-welding and soldering of copper with silver,[1] silver-plating of copper, fixing copper rods with sulphur,[2] huayra, metal nails,[3] utility vessels of gold and silver, vessels with stirrup handle, the alloys Au — Ag and Ag — Cu, wooden shaping-blocks for punching out gold and silver cups, wool-spinning, paccha, quipus with the knots arranged after the decimal system, abacus[4], circular and rectangular chulpas, walls built of truly alternating stones — occasionally of gigantic dimensions, and extremely well joined together without any binding material whatever — fortifications with saw-toothed walls, e. g., Sacsahuaman, fortress walls with loopholes, etc. Not one of these culture elements is "Oceanian". Nearly all of them were in use at the time when America was discovered, and a few may have been recently invented in Peru.

Of cultural elements in Mexico and Central America that were unknown in South America may, among others, be noted cochenille, cacao, the turkey, stone pillars, the cantilever arch, mortar or cement of burnt lime, buildings profusely decorated with sculptures, sets of stones fitted into a building carved so that they together form a figure, clubs set with obsidian splinters, the coolie yoke (also possessed by the Cunas), dolls with jointed arms, teponatzli (also found in the Antilles), delicate feather mosaic fixed on paper, metate on three or four feet (also found in the Antilles),

[1] See Appendix 5 b.
[2] See Appendix 5.
[3] » » 4.
[4] » p. 189.

fine obsidian-polishing, copper tubes for boring stone,[1] an effective writing script, a workable calendar, a sign for o, minus sign, dated monuments, paper, vessels for burning incense, roof-apex cap, juego del volador,[2] turtle-shell drum, a crude potter's wheel,[3] clay vessels built up from a number of pieces, and lacquering with the lac insect[4]. Some of the most important of these culture elements are undoubtedly very ancient, and the majority, if not all, of them were still in use at the time of the discovery of America.

It will thus be apparent that the Indians of Peru and Mexico might have learnt a great deal from each other but had not done so. As regards cultivable plants, there are many South American ones absent in Mexico and Central America, the most important ones because their spreading was prevented by intervening regions where their cultivation was impossible.

Hitherto there has not been discovered in South America a single object of indisputable Mexican or Central American manufacture. A thorough mineralogical examination of the stone beads that have been recovered from Peruvian graves would, however, be greatly interesting, as such investigation may possibly reveal that they have travelled great distances in the course of trading. How well-marked the traces left upon grave-finds by active interchange of commodities are, even for a brief period, is apparent from the abundance in which glass beads have been found in post-Columbian graves on the Peruvian coast, and yet it was not long after the Conquest that the Coast Indians abandoned their ancient form of sepulture. In post-Columbian graves at the mouth of the Amazon river glass beads and other European objects are very commonly found.

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[1] *Sahagun*, p. 376.

[2] *Krickeberg* (2).

[3] » (2) p. 42.

[4] *Coccus axin.*

As regards the numerous culture elements that are common to both of these culture areas but *absent in the rest of America*, it may as a general rule be supposed that they can be explained by cultural interchange; but, if we are to follow a critically scientific method, we cannot simply ignore the possibility of the same inventions having been independently made both in western South America and in the Mexicano-Central American culture area. If we admit that the same invention may have been independently made both in the Old World and in America, it would be illogical to suppose that similar inventions cannot have been independently made in different regions of America. To me it would seem even more natural that two peoples of similar culture and living under similar conditions should be able to evolve some identical invention, than that it should happen to be made by peoples of different civilizations and in different environments. It might be questioned whether adobe, i. e. sun-dried bricks, is not such a twice-made invention in America. It has been shown by Uhle that in Peru in early times (Proto-Nazcan) round lumps of adobe were used as building material, but that at a later period there had been a change into rectangular adobe bricks. North of Peru adobe was in pre-Columbian times only found among the Pueblo tribes, and with them adobe was a late invention. Fewkes considers that in that region crude adobe blocks formed by hand are of pre-Columbian origin.

It is by no means an easy matter to determine where any particular culture element common to Central America and Peru actually originated, although its geographical distribution may be fairly well known, as well as its form variation. We must be careful not to regard this cultural exchange as having been one-sided, or that the Central American Indians alone have been givers and the South Americans the recipients.

It is of course of great importance when by archaeological excavations we are able to show some culture element to

be of greater age in Central America than in South America, or vice versa; but at the present stage of research this is as a rule impossible.

We are presumably justified in assuming that when within a certain area a culture element occurs both in simple and in more developed forms, and in another area only in its more developed forms, its origin lies in the former, if it can at all be said to possess an origin which is common to both areas. Star-shaped club-heads with single or double rows of spikes are of very common occurrence in the western South America culture area, both in stone and in metal. Of stone they are found in Central America and Mexico although sparingly and less complex. Those of metal are never found outside the limits of the Inca kingdom. There is much that speaks in favour of these stone-headed clubs of America originally having been used as digging-sticks (Bushman fashion). Even in more recent times they were used in that way in the extreme south of South America as well as in California. Judging by everything, it is in Peru that the stone heads were first made into star shape. It is of course not altogether impossible that this may have been inspired through "Oceanian" influence.

A field of extreme importance to the cultural influence of western South America upon Central America and Mexico was that of metallurgy. On this subject the Indians of Mexico and Central America did not, so far as we know, possess any knowledge of importance that was unknown in Peru. In the latter region, on the other hand, the Indians as we have seen, knew many things that were unknown farther north. In this respect it appears that South America was the bestowing party and Central America and Mexico the receiving. Rivet has shown how at the time of the Discovery there were discernible two areas between which there existed a considerable difference as regards the metallurgical knowledge possessed by the Indians. One of these areas comprised the Inca kingdom, the other Colombia. In the domain of the

Incas, at the time of the Discovery, there were known bronze, copper, lead(?), silver, gold, and platinum, as well as alloys of gold and copper, gold and silver, and silver and copper. In Colombia were only known copper, platinum and gold, and an alloy of copper and gold, called tumbaga, which there was also used for tools. As has been shown by Rivet, the Peruvian metallurgy appears to have directly influenced that of Mexico, and to have done so through coastwise commercial intercourse. By this means it may be supposed that the Mexican Indians learnt the use of bronze. As bronze presumably only in Incaic times became known on the coast of Peru, it must also in Mexico have become known at a very late period. This points to communication having existed between Peru and Mexico shortly before the discovery of America.

Certain tools of metal which were of common occurrence in Peru but sparingly present in Central America and Mexico, appear to derive their origin from South America. The pincers, for example, an instrument abundantly found in Peru in copper and bronze, as well as in silver and even gold, and in many forms, some of which are typical of the bronze age and others of the copper age[1], is of rare occurrence in Central America and Mexico. As far as can be judged, its American origin lies in Peru, where its development through the copper and bronze ages can be typologically established. The same applies to the metal sewing-needle. The T-shaped axe of metal, which is so typical of western South America, was unknown in Central America and Mexico, regions which were also devoid of the handle-holed axe, probably a late invention in Peru.

It would naturally be of the greatest importance if we could know where and when the Indians began to cast metal à cire perdue, or even by any method at all. This is however a problem which still must be regarded as unsolved, though no doubt it can be solved. Both in Mexico and Central

[1] *Nordenskiöld* (4).

America, as well as in western South America, the Indians knew casting by the direct method and à cire perdue. In eastern North America, on the other hand, these methods were unknown, as there finer metal work was executed in repoussé,[1] a method of ornamentation which in Peru was more ancient than casting, although even there it was in use at the time of the Discovery. All the golden objects in Chavin style that Tello depicts do not appear to have been cast à cire perdue, but their ornamentation to have been produced in repoussé work. As regards the à cire perdue method, this seems to have reached an especially high level of perfection in the Cauca valley in Colombia.

It would also be exceedingly important to know just where the alloy generally known as tumbaga (Au-Ag-Cu)[2] was invented. It was above all known in Colombia and in Chiriqui, but also on the Peruvian coast, in northern South America all the way to Guiana, in the Antilles, and northwards as far as Mexico. In the Antilles, in parts of northern South America, and probably also among the Mayas, the Indians did not themselves manufacture tumbaga, but received it in trade with Colombia and Chiriqui. According to Kroeber,[3] tumbaga was known earlier than bronze on the Peruvian coast. The great invention of alloying metals must therefore have begun with gold and copper. The alloy of copper and tin is in fact a more difficult invention, seeing that tin is not found in a native state but is the form of a mineral (cassiterite) entirely unlike metal in appearance. The great advantage of the alloy Au-Cu is that its fusing-point is lower than that of either component metal. At the present stage of research it may be quite erroneous to assert, off-hand, that tumbaga must have been invented in the locality where objects of this alloy

[1] Handbook, part 1, p. 848.

[2] As to the silver, the Indians could not have been aware of its presence, as it enters into the composition of native gold.

[3] (1) Part II, p. 109.

are found in the greatest abundance, as that circumstance may be due to the supply of raw materials as well as the forms of sepulture. It is nevertheless very probable that tumbaga is a South American, and not a Central American, invention.

Pottery is generally considered the most important field for the study of cultural interchange between South and Central America partly owing to the circumstance that from a great many of regions it is above all clay vessels that have been preserved for posterity. In this field the rule has been to accept Central America as the giver and South America as the receiver, in spite of the fact that the ceramics of the ancient Inca dominion show a greater variety of form than those of Central America, and that the Inca Indians had made much greater progress in naturalistic art. Pottery-making being so much more ancient than metallurgy, cultural interchange may supposedly have been carried on for a much longer space of time in the former field than in the latter. In the field of metallurgy we know, as already mentioned, of several actual inventions possessed by the Indians of western South America that were unknown in Central America and Mexico; but parallels to this are not easily discoverable to any great extent in regard to ceramics.

Of great originality is the portraying art of the Peruvian north-coast Indians and the way they represented the human body with a suggestion of movement out of the frontal plane. Handles fitted with a spout in the middle, of such universal occurrence in northern Peruvian clay vessels, were apparently unknown or very rare in Mexico and Central America. Neither had the Indians of Central America or Mexico evolved any positive inventions in regard to ceramics that were unknown in South America. As mentioned, a very crude inception of a sort of potter's wheel was known among the Mayas and in Mexico,[1] though probably not in Peru prior to post-Columbian times.

[1] *Krickeberg* (2).

If there are few inventions in the realm of ceramics that were known only in one of the civilization areas, we shall on the other hand find that there were many inventions which in one area were of great importance, but rather insignificant in another. Tripod pottery was exceedingly common in Central America, but on the other hand fairly rare in the Inca dominion, while in Mojos in eastern Bolivia it was of common occurrence. The idea of providing clay vessels with three feet appears in America to have originated in Central America. Spouts and handles and ordinary pot lugs were much more common in Peru than in Central America. Pot lids most commonly occurred in Central America. Moulding clay vessels or figures in a form also belong to the ideas that are supposed to have been passed on from Central America to South America. The Indians of South America appear to have possessed far more clay vessels for daily use in water-carrying, etc., than the Indians of Central America. In Central America very likely a considerable proportion of the household vessels consisted of nothing but tree calabashes "Totumas". Thus might possibly be explained why it is that among the Mayas one does not find those immense refuse heaps consisting of potsherds which are so common in South America, both in the western civilization area and in the Amazonas.

Certain ceramic inventions were widely distributed in western South America, as, e. g., tripod pottery, painting of clay vessels before baking, and negative painting. These are also widely distributed in the Amazonas. Others, such as moulding clay vessels in a form, spouts on vessels, and certain forms of handles, occurred in South America only in the western civilization area.

Max Uhle has pointed out numerous similarities between western South America and Central America as regards ceramic ornamentation. These similarities are most conspicuous in western South America as far south as the Chibcha languages extended. A discussion of all the in-

stances adduced by Uhle does not fall within the scope of this treatise, because what to one person may appear a striking resemblance may to another seem more or less fortuitous. Central American influence appears most marked on the coastland of Ecuador.

Nowhere on the Peruvian coast such typically Central American style is met with as the Tiahuanaco and Incaic styles, both originating from the high plateaus of Peru and Bolivia of which the latter, and probably also the former, spread not only through the dissemination of ideas but also in connection with actual colonization of the coast, i. e. migrations.

Of the greatest interest are the comparisons that have been made between certain mythological figures in Central America and South America, whether represented on weavings, clay vessels, or in stone. Of these, the most interesting seem to me to be certain stone figures representing a human being carrying on its back a figure of animal or human shape.[1] These are reminiscent of the demon figures that to our days are carried on the backs of Chocó medicin-men at certain incantations (fig. 7). Stone figures of this kind occur in Central America, Colombia, Ecuador, the Amazonas and, although of bone, at Tiahuanaco (fig. 8).

Extremely interesting seem to me the results arrived at by Lothrop, the eminent expert on Central American ceramics, when in the museums at Lima he searched for similarities between Peruvian and Central American ceramics. Lothrop writes: "During a recent visit to Lima the writer made careful notes in three museums on resemblances to Central America seen in the pottery.

Some days later he had the privilege of going over these collections again in the company of Dr. Tello, who explained his ideas on dating much more fully than as yet he has done in print, A comparison of the notes taken on these two

[1]) *Jijon y Caamaño*, Pl. XVI: Preuss p. 112.

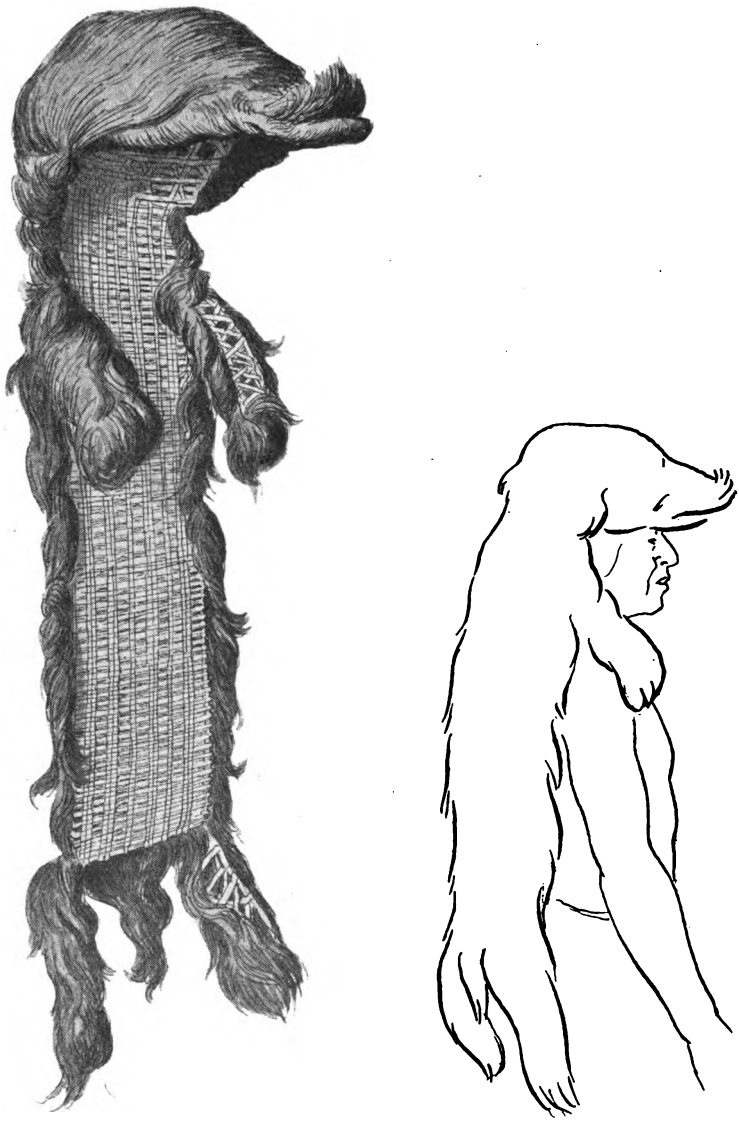


Fig. 7. Demon figure of palmfibers and basketry carried on the back of Chocó medicine-men at certain incantations. G. M. 27. 27. 510. 1/6.

occasions shows that almost every detected likness to Central America in all parts of Peru occured in types to which Dr. Tello assigns an early date — as is also the case with the stratified remains from Ecuador."[1] If this be correct, it is most certainly very far back in time that Central American influence made any appreciable impression upon the ceramic styles of western South America.

We should however bear in mind that because a people has influenced the ornamental style of another people it does not necessarily imply its having essentially influenced the general culture of the latter. In the same way a people may exercise a revolutionizing influence upon the civilization of another people without affecting its ornamentation. Nations are so apt to be led by caprice when it is a question of culture loans. Of entirely different consequences than mere loans of culture elements will of course be an influence disseminating positive inventions such, as, e. g., passing from the stone age to a metal age, the introduction of the art of writing, etc. It is for this reason that I, when comparing the civilizations of Mexico, Central America and Peru, specifically compare the important inventions, those actually constituting cultural progress. We cannot very well declare that the Peruvian civilization is an offshoot of the Mexican or Central American civilizations because we are able to point to loans of certain ornaments, but we should be justified in making such an assertion if we could prove that the architecture, the weaving technique, the most important cultivable plants, irrigation, etc., of the former derive their origin from the latter. Here we must distinguish between things essential and things less essential.

Negative painting on pottery is by Lothrop considered as having originated in north-western South America, a very interesting idea considering the important part

[1] *Lothrop* (1), vol. 2. p. 406.

played by negative painting in the textile industry of the Peruvian coast. Lothrop writes. "Negative painting forms an important technical link between Costa Rica and South America. This process was highly developed in the Andean region of Colombia and Ecuador, and is frequently seen on pottery from Recuay in Peru. To the north it is found in Guatemala and southern Mexico, but never attained great importance there. The development of this decorative process was doubtless due to the use of wax in the casting of metals. It is to be regarded as the great contribution of north western South America to New World ceramics."[1]

Textile art offers no field whatever for instituting comparisons as it is only from Peru we know what progress the Indians attained in this department.

As has been pointed out by Spinden, it is apparent from representations of dress in archaic figures in Mexico that the Indians who possessed these ceramics were probably well advanced in textile art. It is only in North America we find Indians who know the art of weaving, but lack pottery. A similar state of affairs prevails, it is true, among the Patagonians, but these Indians possessed pottery before they became horsemen, and at that time perhaps they did not know the art of weaving. It would be highly interesting if it could be determined whether the art of pottery-making or weaving is the more ancient. It is significant that the Arawakan loom, as I have already pointed out, is of peripheral occurrence in the civilized areas, this type of loom being found in north-western America and the Amazonas. If this invention derives from a common origin, in North and South America it ought to be more ancient than the Peruvian loom, and even perhaps of greater antiquity than the art of pottery-making. I think it may be accepted as a general rule that the earliest type of an invention is found peripherally in the area of its distribution. This

[1] *Lothrop* (1). Vol. 2, pp. 409—410. See also *Jijón y Caamaño*.

has been excellently illustrated by Métraux, among others, in the case of the Indian invention of the manioc press.[1]

I have already emphasized how essentially different the architectural art in Peru and Central America was when at the height of its development. In Peru, the buildings were, comparatively speaking, of severe simplicity but well adapted to practical needs. They were frequently embellished with trapezoidal doors or, on the coast, with stucco work and frescoes. In Central America many of the temples were profusely adorned with sculptures. While in Peru the Indians excelled in solid architecture, those of Mexico and Central America did not know how to lay the stones properly alternating. A building of the Peruvian coast or highland consisted of spacious halls while the temples of the Mayas in proportion to their size contained rooms which were small and cramped. To them the exteriors of the buildings meant so much more than the interiors. Mortar, or cement, of such great importance among the Mayas, was unknown in Peru. The Mayas constructed a sort of arch, but nothing in that line was known outside their territory. They, and they alone, built stone pillars. Circular houses of stone were rare in Central America but common in Peru. On the plateau in the neighbourhood of Lake Titicaca it was even known how to cut the stone blocks so that the outer surfaces of the different stones in the circular houses contained about the same radius. In western South America even the simplest herdsman quite commonly possessed a dwelling house of stone or adobe, while in Central America and Mexico stone as a building material was almost exclusively reserved for temples and similar buildings. North of Peru adobe was only found among the Pueblos.

It is evident that architecture in these two culture areas reached its development in the main independently of any reciprocal cultural influence.

[1] (2) (carte 5).

In the art of architecture there is nevertheless one sphere in which the Peruvian Indians may possibly have been influenced by the northern civilization area, and that is as regards pyramid-building. Even in the matter of details there is in the Peruvian pyramids — which are partly terraced and partly crowned with a building — so much resemblance with those of Central America that it is difficult to suppose they did not have a common origin. Whence the Indians received the idea of building pyramids is beyond our knowledge. It might be conceived that originally they were mounds erected in inundation areas so as to protect temples or other important buildings against floods, and that these mounds were gradually given a monumental appearance, and also built in places where they filled no practical purpose.

Staircases of stone, which, apart from Central America, are very commonly found in Peru — and there already in the pyramids — also constitute a cultural element which is possessed in common.

If in fact the Indians of the Peruvian coast area received the idea of building pyramids from Central America even this would point to Central American influence upon western South America in ancient times.

At this juncture I ought to emphasize that the Peruvian stone architecture perhaps also should be included among the "Oceanian" culture elements. The Cyclopean principle is cognate. It is however only the impulse to build with stones, and very massive ones, that Peru could possibly have received from Oceania.

While Mexican and Mayan stone architecture appear to derive from a common origin, it will thus be seen that South American architecture is something entirely apart. At any rate on the Peruvian coast and in Ecuador, thanks to Uhle and Kroeber, Tello and Jijón y Caamaño, we are able to observe the development of architecture.

Besides pottery and metallurgy there are certain other

parallels between Central American and South American civilization of which I shall give one or two examples.

Trepanning, another "Oceanian" element common to Mexico and Peru, impresses one as having originated in the latter territory, which however may be due to the circumstance that so many more well preserved skeletons have been recovered from the western South American coastal region than from Central America and Mexico. Trophies consisting of skinned human heads, Jivaro fashion, were important in Peru, but rare in Mexico. These probably derive their origin from South America where, judging from everything, the head trophy played a very important part. In fact, on textiles and clay vessels of, e. g., Proto-Nascan and Tiahuanacan style, one continuously sees these trophies carried in the hands of warriors or demons. Here it is also possible to observe clearly, as pointed out by Rydén, the manner in which the idea of manufacturing these reduced human heads has arisen. In the case of Peru we know that head trophies, as already mentioned, were used very far back in time. In Mexico we have no knowledge of them except from the time of the Discovery[1]. So far as I am aware, they are not reproduced on Mexican pottery, contrary to the practice so universally prevalent in Peruvian pottery of different districts and periods. Information as to the occurrence of head trophies of Jivaro type among the Cunas is not to be relied upon. Ruben Pérez Kantule absolutely denies their existence.[2] But on the other hand, heads prepared by the Jivaro Indians are kept for sale in the curiosity shops of Panama, and there bought by "explorers" as curiosities from the Cuna Indians. If, from what I have said in the foregoing, we were to sum up the analysis we have made of the higher Indian civilization of western South America we should

[1] (8) *Rivet-Verneau* p. 49.

[2] The Cuna Indians preserved the painted skulls of their enemies as trophies.

find that there the Indians, judging by everything, had learnt many things from Central America, but that the connection between the Central American and Peruvian Indians did not cause any fusion of cultures. The South American high civilization cannot be said to have been an off-shoot of the Central American or Mexican civilizations, or vice versa. On the other hand, I believe we are bound to assume that the civilizations of western South America and Central America at some very remote period possessed a common origin. By this I do not mean that in some particular locality, say in Central America, at an earlier date than elsewhere, there existed some highly developed civilization from which the South American higher civilizations took their rise, but that in America, in different regions, from a more primitive stage, and more or less independent of each other, the high cultures developed. Here development in the main proceeded on parallel lines, and in parts arrived at very divergent results. The western South American tribes, that at the time when America was discovered possessed — and had long possessed — a high Indian civilization, must have immigrated into South America at some very early date as there does not existe any linguistic kinship between them and Central and North American peoples. Their cultural assets must have consisted of what they knew when they immigrated into South America and, in addition, of inventions subsequently made, supplemented by what they might have learnt through ideas spreading from Central America, and, finally, of notions that might possibly have reached them from Oceania. From Asia they evidently learned nothing since their immigration into South America.

There are also a number of culture elements common to Central America and northern South America, but not found in Peru. Some of them are found in the West Indies and it seems to me we can lay down the rule that when these culture elements only occur in Central America

and northern South America, then Central America has been the contributor in comparatively recent times. But if they also occur in the West Indies and far south in South America, then their origin is to seek in South America or in cultural influences of very remote antiquity from Central America.

Among culture elements that possibly may have passed from Central America to the Amazonas may be noted, among others, bee-culture,[1] earthenware grinding-pans,[2] tortoise-shell scrapers, rattlestaffs, clay vessels with caryatids, stirrup pestles, golden eagles, etc. None of these are counted as "Oceanian".

Among those that are supposed to have travelled in the opposite direction are pile buildings, the hammock, cultivation of the pineapple, duck-hunting with calabashes, the plaited fire-fan, earthenware dishes,[3] rubber ball games, and the wooden seat.[4] Among these are several which are counted as "Oceanian".

It is of course possible that the Indians of northern South America and the Amazonas originally learnt the art of pottery-making from Central America. Spinden compares the archaic ceramics of Mexico and Central America with ceramics discovered in Venezuela and at the mouth of the Amazon river, and has undoutedly found a great deal of resemblance. It should however be noted that although the "archaic" ceramics of Mexico are very ancient, they nevertheless continued to be in existence in the Amazonas at the time when America was discovered. We must always bear in mind that in America certain culture types may in some parts belong to a remote antiquity, while in some other part — even quite near — they may survive as relics.

It cannot be doubted however, that at any rate a proportion of the archaic ceramics of Mexico are of very ancient

[1] *Nordenskiöld* (8) map. 2.
[2] *Linné* (2) map. 2.
[3] *Linné* (2), map 9.
[4] Also rare in Peru.

origin. Of great significance is, as Spinden[1] emphasizes, that archaic pottery does not contain any representations of fantastic beings, such as the feathered snake, the demon figures of the Nazcan ceramics, etc. In Argentina such fantastic representations are only very sparingly found, and the same applies to the Amazonas. From the Antilles they are not known. Very interesting are the head ornaments that are seen on many of the archaic figures, such as turbans. Similar turbans were pointed out to me by Uhle at a visit to the National Museum at Santiago de Chile in mummies archeologically recovered at Pisagua. Head dresses resembling turbans are still in use among the Zapotecs.[2]

Whenever a dwelling-site is found to contain two archaeological strata bearing different ceramics, the lower one is naturally more ancient. If then in some other more or less distant spot an archaeological stratum is discovered to contain ceramics resembling those of the later stratum, and in a third spot there is a stratum of ceramics resembling the earlier stratum, then it is possible that in the last mentioned spot the ceramics are of a later date. Of this we find numerous examples when we study the archaeology and ethnography of the Amazonas. To this day there is, e. g., on Rio Xingú manufactured ceramics which, if met with in the lower Amazonas by archaeological investigators, would be considered an archaic type. Tribes living adjacent to each other may possess entirely different ceramics, as for example the Chiriguano and the Tapiete in El Gran Chaco. Those of the former are beautifully painted before burning, while those of the latter are unpainted or merely provided with a few primitive dots or lines applied after baking. Were an archaeologist to come upon these two dif-

[1] "Archaic art is a pretty certain index of religion then in vogue. There is a notable absence of purposely grotesque or compounded figures representing divinities such as will be found in the later horizons," Spinden(2) p. 52.

[2] *Spinden*(2), Pl. V.

ferent kinds of pottery of entirely divergent range of form in two dwelling-sites situated only a few miles apart from each other, he would in all probability consider them as belonging to periods widely separated in time. These two kinds of ceramics may be contemporary at the present time, but have not, of course, always been so. The Tapiete ceramics still remain at an archaic stage as, among other things, painting of clay vessels before baking is unknown.

The following culture elements, which evidently originate in the civilization area of north-western South America or Central America, are at the same time found in northern South America: the suspension bridge, naringuera, tripod ceramics, clay vessels provided with lids,[1] negative painting, cylindrical stamps,[2] tumbaga and deep-level graves,[3] and skull deformation. None of these culture elements are found on the upper Rio Xingú or among the Tupinambá.

All the culture elements just referred to, with the exception of cylindrical stamps, are also known from Peru. Of especial interest is cranial deformation, both on account of its peculiar distribution in North America, and because in many instances this practice has been archaeologically proved not to belong to the most primitive civilization. The primitive fishermen population of Arica on the western coast of South America did not practice skull deformation, neither did the Ciboney in Cuba, nor the Basket-makers in south-western North America. On the other hand, as has been shown by Tello, skull deformation was already known in Paracas. If the northern coast of South America be excepted, skull deformation in that continent was of a pronouncedly western distribution.

Central American civilization has also directly influenced the West Indies, as there are found culture elements that

[1] *Linné* (2) Map 10.
[2] » (2) » 4. Also found in the West Indies.
[3] » (2) » 13.

are common to the West Indies and Central America but which do not occur in South America, such as the teponatzli, and a metate provided with feet.

Finally, I ought to remark that the South American Indian civilization includes certain elements that have been adopted in post-Columbian times from negroes and Europeans, and have so completely merged into this culture that it is only through the most careful investigation that proofs of their origin can be established.

Among these we find, e. g., the side-blown trumpet, the musical bow, the pellet-bow, the cotton-cleaning bow, the pump-drill, the cast-net, and the spring-hook.

As regards the musical bow, it still remains an open question whether it is, or is not, post-Columbian. That the pellet-bow in America is post-Columbian I consider myself to have proved, and would refer the reader to the works in which I have dealt with that problem.[1]

Résumé.

1) In the extreme south of South America a great number of culture elements exist that are also found in North America, but not in the intervening regions. These culture elements are generally very important in North America, while in South America their occurrence is merely sporadic.

2) In south-western South America and the Gran Chaco are found a great many noteworthy resemblances to Indian culture in south-western North America.

3) The culture elements under (1) and (2) occur to an essential degree in northern Asia.

4) In Central America, Colombia, the Amazonas, and partly also in Peru, there occur a fairly large number of culture elements, parallels to which are found in Oceania.

[1] (1), (2).

5) Some of these elements occur sporadically in North America, conveying — if in South and North America they derive from a common origin — the impression of being culture loans that have passed from the southern to the northern continent.

6) Cultural influence from Oceania — so far as we are able to speak of such a thing — must in the main date from some exceedingly remote past, before the banana, sugar-cane, fowls, and domesticated pigs were known in Oceania.

7) The art of metallurgy, at any rate from the point when metal casting became known, is in America an independent invention. The higher cultures from that time are uninfluenced by Asia.

8) The resemblances that exist between the high cultures of Central and South America are due to cultural intercourse and not to migrations.

9) Central American influence upon the culture of Amazonas is essentially of a later date than the Arawakan emigration to the West Indies.

10) Central American influence upon Peru lies very far back in time, whilst Peruvian influence towards the north is of a later date.

11) The Peruvian civilization was built up of intensified Indian culture, and not by anything additional or alien.

12) The same applies to the Central American culture.

13) The Indians have achieved a large number of independent discoveries and inventions that were unknown outside of South America, and which chiefly occurred among the agricultural peoples.

14) The civilization of the Amazonas does not to any appreciable extent appear to have developed in the form of adjustment to environment by people having come from an arctic or temperate climate to a tropical one, owing to the fact that in this region the Indians — although their ancestors originally came from North America — have completely adjusted themselves to their new environment.

15) In Central America and Mexico few culture elements occur that are not also found in South America. Certain of these have however been of great importance, the leading ones undoubtedly being of pure Indian origin.

16) In North America, north of Mexico, are found a considerable number of culture elements that do not occur in South America, although nearly all of them exist in northern Asia.

17) Most South American culture elements that are of fundamental importance to the Indians in the struggle for existence were invented in that continent, or common to South and North America.

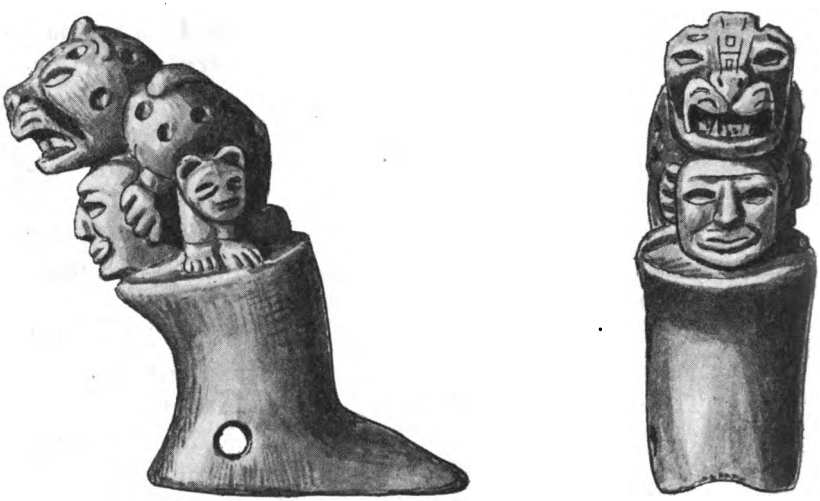


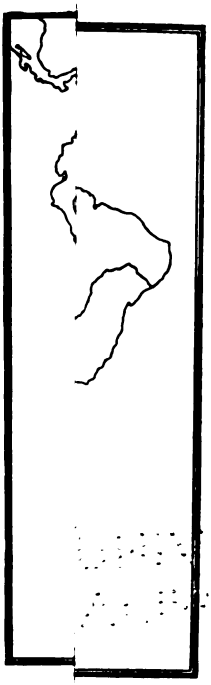
Fig. 8. Bone detail of spear-thrower from Tiahuanaco. Prof. Posnanskys Collection.

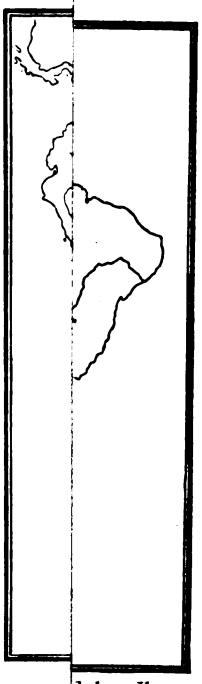
1. Sweating house.

2. Pit dwellings.

9. Leggings.

10. Moccasins and slippers.





d handle.

APPENDIX I. (To Table I).

Below is given a detailed account of the distribution of certain culture elements referred to in Table I, which till now has only been published in Swedish.

Sweating house. (Map 1.) The sweating-house, as we know, is very widely distributed in North America. In South America I only know of it among the Comechingones (312) of Sierra Cordova in Argentina, whence it is reported by Narvaez, as first pointed out by Outes.[1] From his description it is evident that those Indians possessed steam baths dug into the ground like those with which we are so well acquainted in North America. Narvaez' report on these Indians, who are very little known and early became extinct, dates from 1583.

The occurrence of the bath house among the Comenchingones is not easily explained as an adjustment to environment. In North America the sweating house extends from Canada to Central America, but is absent in the far north among the Eskimo.

Pit dwellings. (Map 2). These are in North America distributed to a considerable extent. Of this, Sarfert has published a map. In South America these more or less underground huts are described among the Juries,[2] or

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[1] *Outes* (3) "Y usan otra cosa, ques meterse en casas debajo de la tierra y muy abrigadas á sudar, como manera de baños, y de alli salen despues que sudan mucho á que les dé el aire, aunque se enjugan dentro." Relacion de las provincias de Tucuman que dio Pedro Sotelo Narvaez.

[2] *Cabrera*, p. 141, — "Son bajas las casas é la mitad de la altura que tienen esta debajo de tierra y entran à ellas como à sotanas." — See also Litterae Annvæ, Societatis iesv Anni 1589. Romæ 1591, p. 417.

Tonocotes (328), of the Gran Chaco, and the Goainazes (352),[1] on the south coast of Brazil. Among the Caupezes of northern Chaco they are mentioned by Rodrigues do Prado.[2] The Tsirakua Indians (93), I gathered from my travels, are supposed to live in huts of this description. The huts of the Quichuas, near Cojata (18) north of Lake Titicaca in Peru, are also, as I have myself seen, partly sunk in the ground. Extremely remarkable underground dwellings with entrance from the roof have been discovered by Tello at Paracas (A) on the Peruvian coast. In the Chaco and northern Argentina the partly below-ground huts may be explained as an adjustment for protection against the high winds, and north of Lake Titicaca against the cold.

Houses with porch. (Map 3). Besides among the Eskimo, huts of this kind are found, according to Sarfert, over a large region of eastern North America as well as in a smaller area in California. In South America I know them among the Chorotis (1), Ashluslays (2) and Matacos (6). These, too, may be considered as an adjustment to the bleak southerly winds through the winter months.

Plank-built houses. (Map 4). Houses of this kind, so well known from north-western North America and California, are in South America only known from the Araucanians (10) among whom they were in use in ancient times.[3]

Tents of animal skins. (Map 5). These are known from the Tehuelches (26),[4] Onas (27),[5] Pampas

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[1] *Soares de Souza*, p. 100, — "Não vive este gentio em aldeias com casas arrumadas, como os Tamoyos seus visinhos; mas em covas pelo campo debaixo do chão, onde tem fogo de noite e de dia, e fazem suas camas de rama e pelles de alimarias que matam. A linguagem d'este gentio é differente da de seus visinhos, mas entendese com os Carijos; são na cör e proporcão do corpo como os Tamoyos, e tem muitas gentilidades, como o mais gentio da costa".

[2] p. 26, "Moram en casas subterraneas". (Not shown on the map.).

[3] *Cooper* (1), p. 201—204. — *Medina*, p. 161.

[4] *Outes*, (1).

[5] *Cooper*, (1) p. 192.

(325),[1] and Changos (346).[2] In shape they do not at all resemble the North American tipis, the South American variety being merely a sort of wind-screen.

Ladder-like baby-carrier or cradle. (Map 6). In all northern and north-eastern South America the Indian mother carries her baby sitting in a broad strip of cloth slung over one shoulder. The Quichua and the Aymara carry their babies in a shawl on their backs. In the extreme south of South America the Onas (27),[3] Tehuelches (26),[4] and Araucanians (10),[5] carry their babies in a small, ladder-like cradle. On the Peruvian coast (A) dolls have been found attached to miniature ladders of this kind.[6] To this day these appliances are found in use, although rarely, among the Quichuas (18).[7] The child is tied to the ladder-like carrier. If the mother wants to put it down she leans the baby carrier against a tree or something. As the lengthwise sticks are pointed, she can also simply drive them into into the ground. Walter Pflug has written a treatise on the distribution of the cradle all over the world. Apart from the ladder-like pattern, we find the cradle in South America only among the Omagua Indians (68) in the upper Amazonas. These are shaped like a small boat, and it may be supposed that their primary function is connected with the skull deformation of infants which is typical of this tribe. In North America the sling-formed baby-carrier is absent,[8] while stationary cradles, or cradles of ladder shape, are in widespread use.

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[1] *Lozano*, (2) Vol. I, p. 431.

[2] *Medina*, p. 163, with bibliography.

[3] G. M. 2176. *Cooper* (1), p. 171.

[4] *Outes*, (1) p. 261.

[5] Photo, G. M.

[6] *Reiss, W and Stübel, A.*, Pl. 89: 2 etc. Pl. 90: 3.

[7] *Hardy, Osgood*, Pl. II.

[8] Typically enough, in North America is also absent the sack-like woman's dress called "tiru" or "tipoy", which I have tried to show shares its origin with the sling-shaped baby-carrier. (See Comparative Ethnographical Studies, Vol. 2. 64—65).

Skin mantles. That clothing made of skins is found in the extreme south of South America, as well in North America north of Mexico, is natural in view of climatic conditions. What is remarkable is that while the North American Indians, and in particular the Eskimo, have learnt to manufacture skin clothing exceedingly well adapted to its purpose, the Indians of South America exclusively use rough mantles or wraps of animal skins. As women's clothing the skin mantle occurs in the Gran Chaco even north of the tropics, which is supposedly due to the Indians having been driven northwards by the whites. Map 15 in Vol. 1 of my series, Comparative Ethnographical Studies, shows the geographical distribution of the skin-mantle.

Loin wraps of tanned deerskin. (Map 7). As is well known, the North American Indians make extensive use of tanned deerskin for shirts, etc. Nothing similar is known to me from South America except in the Gran Chaco, where the Ashluslay (2)[1] and the women of the Lengua Indians (8)[2] wear round their hips wraps consisting of pieces of tanned deerskin, sewn together. Several Chaco tribes wear belts of tanned leather. Neither in North nor South America are the skins bark-tanned, but only prepared by mechanical treatment and rubbed in with liver and fat.

Fringed Leather. (Map 8). The skin clothes of the prairie Indians are generally ornamented with fringes produced by cutting up the skin into narrow strips. Fringed in a similar manner are also usually the belts of the Chorotis (1) the Tobas (7),[3] Ashluslays (2),[3] Matacos (6),[3] and Lenguas (8).[4] I have not seen anything similar in the rest of South America.

Leggings. (Map 9). Leggings, so widely distributed, as we know, in North America, I only know in South Amer-

[1] G. M. 13.1.336.

[2] *Grubb*, Picture opposite p. 214.

[3] Personal observations.

[4] R. M., Everett's collection.

ica from the Onas (27)[1,2] Yahgans[3] and the Tobas (7)[4]. The Tobas use them for protection against thorny plants, and they can therefore be classified as an adjustment to environment. One might, however, ask oneself why it is that no other Indians in South America, where thorny plants everywhere abound, have hit upon the idea of making use of leggings. Why are these articles of clothing only found in exactly that part of South America where the greatest number of parallels to North American Indian culture occur?

Moccasins and shoe-hay. (Map 10). While a great proportion of South American Indians, particularly in the western culture area, use sandals, the Tehuelches (26)[5] formerly wore, and the Onas (27)[6], Yahgans (XV)[7] and Alakaluf (IV)[7] at the present time wear, moccasins. Palavecino has recently shown that also the Toba-Pilagas (9) of the Gran Chaco possess moccasins. These they stuff with dried grass, as is also commonly done in North America. The use of moccasins as a protection for the feet against cold may of course have been invented independently both in North America and in the extreme south of South America.

Slippers (polcos) are used by the Aymaras (19) and Quichuas (18) on the eastern slopes of the Andes in the border regions of Peru and Bolivia. As has been pointed out by Montell[8], slippers of this kind are worn by Aymara Indians in pictures published by Poma de Ayala. Slippers has also been found in graves on the peruvian coast. (A).[9]

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[1] *Gallardo*, p. 155.

[2] *Cooper*, 194.

[3] *Lothrop* (2) p. 57 (not on the map).

[4] R. M. To. 25.

[5] *Outes* (1) p. 258 (After *Pigafetta*) »Como calzado usaba pedazos de cuero cosidos con tendones y cuyo interior se llenaba de paja.»

[6] *Gallardo*, p. 155.

[7] *Cooper* (1), p. 194. *Lothrop* (2) fig. 46.

[8] (2) p. 209 f.

[9] *Uhle* (8) Pl. 7, fig. 3. *Max Schmidt* (1) p. 522.

Embroidery on leather. (Map 11). Peculiar to a great proportion of the Indians of North America is their custom of embroidering their clothes with porcupine quills, glass beads, shells of Dentalium, etc. I do not know of embroidery on leather in South America except from the Mataco Indians (6) of the Gran Chaco, among whom I have collected a number of embroidered leather bags (fig. 9). In

Fig. 9. Embroidered leather bag from the Mataco Indian of Gran Chaco. $^1/_6$.

this connection it may be mentioned that embroidery on cloth is of rare occurrence in South America. Spangling with beads of mollusc shell, corresponding to the sewing on of glass beads, etc., was in South America a western custom which nowadays is only found in the Gran Chaco.

Three-feathered arrows. (Map 12). If we have spread before us a collection of Indian arrows from various parts of South America, there are among them, I think, none that are so North American in appearance as

those of the Ona Indians. Like the majority of North American arrows, they are stone-pointed. Stone-pointed arrows were anciently distributed widely over South America. All over Argentina, in Chile and in Bolivia, arrow-heads of stone have been found most abundantly. Similar arrow-heads have also been found in Brazil in districts where the Indians nowadays exclusively use arrows pointed with wood, bamboo, or bone. Most North American arrows are provided with three feathers, while all South American arrows one meets with, if they are feathered, have two feathers. It is therefore exceedingly interesting that the Indians of southern South America at the time of the Discovery used *three* feathers on their arrows. Such are mentioned by Oviedo from the Timbus and the Carcaraes (311)[1] on Rio de la Plata, and from the Patagonians (26)[2]. The Cainguas (21)[3] are still using, or did a short time ago use, arrows with either two or three feathers. Mr. Carlos Estevão de Oliveira in Para has in his private collection a four-feathered arrow from the wild Paracaña Indians, left behind after an attack on the "civilized" people.

Fish glue as arrow-feather fastening. (Map 13). In North America, as for example in California, it is not uncommon for Indians to attach the feathers to their arrows by means of fish glue. I have looked in vain for anything of the kind in the extensive South American collections of the Gothenburg Museum. There it is principally wax or wax mixed with resin that, in conjunction with thread or fibre, has been used for affixing the arrow feathers, but not fish glue. In ancient times fish glue was, however, not unknown in southern South America. Dobrizhoffer[4] thus relates of the Vilela (353), a Chaco tribe, that they

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[1] Vol. 2, p. 192.

[2] »Los arcos eran cortos y recios y anchos, de madera muy fuerte, y las flechas como las que usan los turcos y con cada tres plumas.» From the expedition of *Loayza*. (After *Johan de Areyçaga*). Vol. 2, 4. 40.

[3] *Ambrosetti* (2).

[4] Vol. 2. p. 356.

attached the feathers to their arrows with a kind of glue which they obtained from the air-bladder of the "bagre" fish. It is not impossible that the arrows that Lehmann-Nitsche[1] recovered from ancient graves in Puna de Jujuy had their feathers fixed in that way. As can be seen from the map, the Vilela dwelt not far from Puna de Jujuy (D).

Arrow quivers. (Map 14). The quiver, formerly used by the majority of the Indian tribes of North America, is only rarely met with in South America. It occurs among the Onas (27[2] and the Alakaluf (IV)[3], and in northern South America among the Motilones (37)[4], as described by Bolinder. Among the Menimehes (335)[5] quivers are mentioned by Whiffen. Montell[6] describes a leathern quiver recovered at Chiu-Chiu (316) in northern Chile. From early literature it is however apparent that quivers of this kind were used by Araucanians (10)[7] and on the island of Chiloe (315)[8], Patagonians (26)[9], Abipones (17)[10], Mocovis (164)[11] and Charruas (324)[12] in southern South America, and by Guahibos (54)[13], Guypunavis (202)[14], and Corbagos (336)[15], as well as by Indians on the island of Trinidad (S)[16] in northern South America.

[1] p. 6. "Mas arriba de este anillo hay unas barbas de plumas pegadas a los dos costados",

[2] G. M. 3791; *Cooper* (I), p. 210.

[3] *Cooper* (I), p. 210.

[4] *Bolinder*, (I).

[5] p. 117.

[6] *Montell*, (I) p. 10—12, fig. 12.

[7] *Medina*, p. 134. Bibliography, including among others Pedro de Oña, "Carcax de piel de tigre".

[8] *Medina*, p. 135.

[9] *Outes* (I) p. 254 and bibliography.

[10] *Dobrizhoffer*, Vol. 2 p. 355. "The quiver is made of rushes and adorned with wollen threads of various colours".

[11] *Baucke*, fig. 13.

[12] *de Azara*, t. I.

[13] *Rivero*, p. 222.

[14] *Solano*, p. 277.

[15] *Oviedo*, Vol. II p. 281. "Sierra Mene". Quiver for both bow and arrows.

[16] *Castellanos, Juan de*, Canto V, p. 95.

On the face of it, I am inclined to think that here it is a case of twice-repeated dissemination. If so, in Southern South America the arrow quiver would belong to the same cultural stratum as the culture elements referred to in the foregoing, while in northern South America it may possibly constitute an imitation of the quiver for blowgun darts.

Composite bows do not occur in South America. It is typical of the bows of southern South America that the bowstrings, as in North America, consist of some animal material, such as strips of skin or sinews.

Large harpoon-heads of bone. (Map 15). The Fuegians' (27), (IV), (XV) harpoon- and spear-heads of bone[1] are in part of the same shape as e. g., those, found in the State of New York[2], in south-eastern Canada[3], and on the north-western coast of North America.[4] A harpoon-head of this kind has been found on the Patagonian coast (295), as described by Outes.[5]

Striking fire with pyrite and flint. (Map 16). Unlike all other South American Indians, who drill fire with wooden sticks, the Fuegians (27), (IV), (XV)[6] produce fire by striking pyrite against flint, a fire-creating method once fairly generally practised in the extreme north of North America.[7] Tessmann relates of a number of tribes in north-eastern Peru that they made fire by striking two stones together. One wonders whether this method not is

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[1] *Cooper* (1), p. 205—207.

[2] *Parker.*

[3] *Wintemberg.*

[4] *Smith, Harlan I.*

[5] *Outes,* (2).

[6] *Cooper* p. (1) 191; G. M. 16, 1. 1.

[7] "Among the Eskimo, northern Athapascan and Algonquian tribes ranging across the continent from Stikine r in Alasca to Newfoundland and round the entire arctic coast and also throughout New England; as well as by the tribes of the N. Pacific coast." Handbook of American Indians. Vol. I. p. 459.

of i recent date in this region and has been employed by the Indians after having learnt from the whites to strike fire with flint and steel.

Water-boiling with heated stones. (Map 17). In large tracts of western North America where pottery is absent, as, e. g., in California and among the prairie Indians, water is boiled in such a way that stones are brought to a fierce heat and then dropped into a vessel containing water. "Stone-boiling" of this kind is in South America only known from the Chonos (141), Yahgans (XV) and the Onas (27). In its true form this practice appears, strictly speaking, only to have occurred among the first mentioned tribe.[1]

"Stone-boiling" might quite possibly be a culture element introduced into America from Oceania. However that may be, as a culture element it appears exceedingly ancient in South America, where it is only surviving in the extreme south.

Vessels of bark sewn together. (Map 18). The Yahgans (XV) and the Alakaluf (IV) possess vessels of this kind. Formerly they were also in use among the Chonos (141).[2] In the remainder of South America and in Central America no parallel is found to these bark vessels. In northern North America, as we know, they are very widely distributed.

Leathern water bags. (Map 19). The Onas (27), like the prairie Indians, use leather bags for carrying water.[2] Such water bags are also mentioned by Philippi from the Changos (345).

Toilet implements: brush and comb. (Map 20).

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[1] "The Chonos were familiar with the use of hot stones for cooking fish in their *bark* buckets (*Rosales*, a, vol. I. 151; b, cited by *Medina*, p. 186) but the practice is not found among the Fuegians. Heated stones are, however, used by the Onas for heating or toasting *tay* seeds (*Gallardo*, p. 173—174; *Cojazzi*, p. 61), and Dr. *Hyades* writes of the Yahgans: »Ils se servent de cailloux chauffés au feu pour faire fondre la graisse et tiédir l'eau dans lesquelles ils plongent ces cailloux (q, 340; cf also 310)." *Cooper* (1), p. 191.

[2] *Cooper* (1), p. 205.

[3] *Cooper* (1), p. 205.

It is very characteristic of the North American Indians that, contrary to the Indians of the greater part of South America, they do not as a rule use composite combs, i. e. slivers of wood, or other material, tied together. ("Stäbchenkämme", as called by the Germans). Either they use hair-brushes,[1] or else combs, which latter are cut out of one piece of material, generally bone.

It is only in the far south of South America that, as in North America, hair-brushes made of hair or roots are used, whilst in the Chaco and adjoining regions combs cut out of one piece occur. In the Chaco also runs the southern limit of the geographical distribution of the composite comb.

The distribution of the hair-brush in South America I have shown in Map 23 in Vol. I of my Series "Comparative Ethnographical Studies". It is highly interesting that while in more recent archaeological strata at Arica, Uhle found composite combs, in earlier strata originating from a primitive fisherman population he only found hair-brushes.

The comb carved in one piece occurs among the Choroti (1),[2] Tapiete (3)[3], Chiriguano (4)[4], Chané (5)[5] Mataco (6)[6] and the Tierra del Fuego Indians[7]. A comb of this kind,[8] recovered at Humahuaca in northernmost Argentina has also been described by Debenedetti. Another one has been found by the same writer at Kipon[9] (330).

Plank-sewn boats. (Map 21). The type of boat made by sewing a number of planks together, as that found among the Chonos (141)[10] and the Alakaluf (IV)[10] and on the

[1] Occasionally of the tail of a porcupine.
[2] G. M. 13.1.2.
[3] R. M., L. 52.
[4] R. M., E. 344.
[5] R. M., P. 69.
[6] R. M., M. 374.
[7] *Lothrop* (2). Post. colnmbian? (Not on the map).
[8] *Debenedetti* (1).
[9] *Debenedetti* (2).
[10] *Cooper* (1) p. 198—200.

island of Chiloe (501)[1] is unknown in any other part of South America. It is possible that the Indians of southern California formerly possessed a similar kind of boat constructed of planks sewn together. Not least remarkable is the use of planks for this purpose. I do not know of any Indian tribe in South America apart from these Fuegian tribes and the Araucanians that possessed the knowledge of adzing out planks, properly speaking. In North America it is presumably only on the western coast that the Indians used planks, and this naturally to an extent vastly different from what was the case in southern South America.

Crotchless paddle handles. In Part 3 of my "Series" I have published a map (23) showing the geographical distribution of different South-American paddle forms. It is evident that the crotchless paddle is of southerly distribution, although it extends farther northwards than as a rule is the case with other culture elements here dealt with. In North America, excepting the north-western regions, the Indians had crotchless paddles.

Double-bladed paddles. (Map 22). The double-bladed paddle is known from the Agaces (323) on Rio Paraguay[2] and from the northern coast of Chile[3]) In a grave at Arica in Chile Professor Skottsberg (B)[4] found a miniature model of a double-bladed paddle. And, as Métraux[5] points out, Lery states that the Tamoyos on Rio de Janeiro had double-bladed paddles (500). In North America, apart from the Eskimo, the double-bladed paddle was only known in southern California.[6]

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[1] *Latcham.*

[2] *Oviedo,* Vol. II, p. 193. "É siguiendo su viaje toparon una gente que laman a g a ç e s, que es belicossa en el agua, y tienen muchas canoas y los remos dellas son de dos palas en los extremos, y assi uevan muy ligeras sus cauoas; estas palas son combadas y de palo."

[3] *Frezier,* Planche XVI.

[4] *Skottsberg,* fig. 10. G. M. 19. 1. 7.

[5] (1)

[6] *Kroeber* (2) p. 813. »The rush raft . . . was by the Costanoans propelled with a double paddle.»

At the Gothenburg Museum there is a double-bladed paddle from the Arawaks of the coast of Guiana. It is, however, most certainly not of Indian origin.

Scalping. (Map 23). Scalping still occurs in the Gran Chaco, among the Chorotis (1)[1], Ashluslays (2)[2], Matacos (6)[3], and Tobas (7)[4]. Anciently, scalping was practised by the Abipones (17)[5] and the Mbayas (12).[6] In the Chaco as in North America scalps are stretched over a wooden ring.

Besides in the Gran Chaco, scalping occurs among the Açurini Indians (326), according to information and photographs received by the Gothenburg Museum from Nimuendajú. There is also a statement as to the occurrence of scalping in Guiana, although of doubtful authenticity.

Numerous South American tribes have in old times been, and a few to this day remain, head-hunters.

Smoke-signalling. (Map 24). Signalling with smoke, which is so well known among the North American prairie Indians, is in South America of a southerly distribution. It is known among the Onas (27),[7] Tehuelches (26),[8] Araucanians,[9] Aymaras (19)[10] and Guenoas (329),[11] as well as among the Chaco Indians in general.[12]

Rawhide rattles containing pebbles. (Map 25). Rawhide rattles, which are common in North America, as, e. g., among the Mandans and the Hidatsas, are in South

[1] From what I heard on my travels among these Indians.

[2] R. M., A. 1616.

[3] G. M. 13. 1. 616.

[4] *Cardus*, p. 260.

[5] *Dobrizhoffer*, Vol. 2, p. 408—409.

[6] *Schmidel*, p. 78.

[7] *Cooper* (1), p. 192.

[8] *Cooper* (2). p.

[9] Medina p. 128 (After Ercilla), nou on the map.

[10] *Bandelier*, p. 89.

[11] *Lozano* (2), vol. I. p. 412.

[12] *Lozano* (1), p. 351. "Y faltandoles toda seguridad, para poderse avisar unos á otros del manifiesto peligro, que corrian sus vidas, se communicaban, y hablaban como hijos de la confusion gentilica, con lenguas de humo, que es la seña con que de lejos se entienden, y hablan." —

America only known among the Tehuelches (26).[1] At Arica (B), Uhle[2] has found rattles of this material.

Dancing with deer-hoof rattles. (Map 26). One of the most remarkable parallels between Indian culture in northern California[3] and in the Gran Chaco is that in both places rattles made up of deer-hoofs are used at the ceremonies connected with girls' reaching nubile age. When among the Ashluslays (2)[4] a girl attains her first menstruation, the women dance round her, carrying in their hands sticks to which bunches of deers' hoofs are attached. The same practice prevails among the Lenguas (8).[5]

Tortoise shell rattles. (Map 27). Rattles consisting of a tortoise-shell tied on to a wooden handle are in South America only known from the Chamacocos (11).[6] In eastern North America rattles of this kind are not uncommon.[7]

Hockey. The North American Indians have a great variety of games and pastimes. There is only one region of South America, viz. the Gran Chaco, where any considerable number of games is known, and between these and those of North America there prevails a remarkable resemblance, as I have already pointed out in a former treatise. In the Chaco and among the Araucanians there is the game of hockey, which in North America is widely distributed. The Chiriguano, like many Algonkin and Iroquois tribes, play with rackets (See Map 28 in Vol. I of my "Series").

Ring-and-pin game. (Map 28). When I wrote my treatise on resemblances between Indian games in the Gran Chaco and in many parts of North America I did not know that "ring-and-pin games" occur, or, more correctly, formerly occurred, in the first mentioned area. That excel-

[1] *Outes* (1) p. 259.
[2] *Uhle, Max.* (12).
[3] *Kroeber* (2), p. 862.
[4] From personal observation.
[5] *Grubb,* Picture facing p. 182; p. 177.
[6] *Boggiani,* fig. 33.
[7] Handbook of American Indians, p. 960.

lent Jesuit, Sanchez Labrador,[1] gives, however, a detailed description of this game among the Mbayas (12).

"Monitor pipes". (Map 29). In Patagonia the tobacco pipe is not Considered as having been introduced until long after the conquest, for the reason that pipes are not referred to in the earliest travel stories. As I have pointed out, neither is tobacco-smoking mentioned in any early account of travel from the coast of Brazil or from the Gran Chaco. In several graves which, judging by everything, are pre-Columbian, such as, e. g., those at Tarupayu and Caipipendi in south-eastern Bolivia, pipes have nevertheless been found. I have tried to explain this in such a way that tobacco-smoking in pre-Columbian times above all was a magic ceremony which the Indians kept secret from the whites. Oviedo, who was the first to mention smoking on the South American continent, refers to it in connection with the incantations of a medicine man. This was on the Rio Orinoco.[2]

Monitor-shaped pipes are widely distributed in eastern North America.[3] In South America I have found pipes of this kind in graves at Caipipendi (322)[4] and at Tarupayu (322).[5] They are also known from the area covered by the Araucanians (10)[6] and from the Tehuelches (26).[7]

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[1] *Sanchez Labrador*, Vol. II, p. 11. — "Hacen cincuenta y seis ó sesenta argollitas de la corteza dura de una especie de calabaza amarga. Por medio de todas pasan un hilo largo una vara. La una punta está atada á la ultima argollita, y la otra á un palito pulido de casi tres cuartas. Dejan caer todas las argollitas, que estribando unas en otras, están bien juntas. Después las despiden al aire, enderezando al mismo tiempo la punta del palito á la primera. No sueltan el palito, y la habilidad consiste en ensartarlas todas al aire, y el que lo logra, gana. Juéganle muchos en rueda, porque ensarte ó no los arollas, la destreze se prueba una vez sola, y después espera que concluyan los demás de la rueda". —

[2] See Summary in Part 5 of my series, "Comparative, etc", pp. 73—74.

[3] *Mc Guire*.

[4] R. M., K. 65.

[5] G. M. 15. 2. 58 F.

[6] G. M. 21. 10. 26.

[7] *Musters*, p. 177, fig. 22.

The tubular pipes that are commonly used in the Gran Chaco are of sporadic occurrence in different parts of the South American continent. This kind of pipe is widely distributed in North America.

Coiled basketry. (Map 30). Spirally built up baskets — so-called "coiled basketry" — occurs in South America in the south and west. In the Gran Chaco I have found this technique as a great rarity among the Mataco (6). The culturally allied tribes of the Chorotis, Ashluslays, Tobas and Lenguas possess no basketry. Coiled basketry is besides known to me among the Onas (27),[1] Alakaluf (IV),[2] Yahgans (XV),[3] and Araucanians (10).[4] Baskets in this technique have been found at Calama (316)[5], and Arica (B)[6] in Chile, as well as in the Chulpas (343)[7] in the borderland between Peru and Bolivia at Mollendo (A)[8] in Peru. Clay vessels with basketwork impressions have been found at Sierra de Cordova (312)[9] in northern Argentina (E)[10] and at Viluco, Mendoza (370).[11] Among civilized Indians or mestizos, coiled basketry has been described by Uhle in Guaillabamba in Ecuador and in Bogota.[12] (Not marked on the map). In Colombia and Panama coiled basketry is found among the Chocós[13] (219) and the Cunas[14] (372). Baskets woven by this technique are even to-day met with by Nimuendajú among the Mundurucu Indians[15] (56). These Indians also possess another culture element in common with

[1], [2]), [3]) *Cooper* (1), p. 204.
[4] G. M. 21. 10. 78.
[5] *Montell* (1).
[6] G. M. 19. 1. 46; *Skottsberg.*
[7] Queara Valley R. M. 06. 1. 530.
[8] R. M. 05. 17. 81.
[9] *Gardner; Outes* (3) fig. 99—100.
[10] *Boman,* Pl. II, fig. 3.
[11] G. M. 26. 13. 11, M. *Métraux's* coll.
[12] *Uhle* (6) Vol. II Pl. 8, fig. 13, 14.
[13] G. M. 27. 27. 265.
[14] G. M. 27. 27. 1059.
[15] G. M. 26. 25. 6.

south-western South America, and this consists of the typically elegant wooden slabs on which they grind their parica snuff.[1] According to a letter received by me from Nimuendajú the Canella (5 x) and the Apinagé (502) also have coiled basketry.

Rod armour. (Map 31). One of the best known parallels between southwestern South America and North America is rod armour, the distribution of which latterly has been studied by Krickeberg.[2] In North America it is known in its north-western region, among the Eskimo and among the Iroquois. In South America it is known among the Araucanians (10), as is apparent from a description of it by Gonzalez de Najera, cited by Medina[3]. In his treatise entitled "Dress and Ornaments in Ancient Peru", Montell expresses doubts as to rod armour having been known on the Peruvian coast, as hitherto has been generally supposed.[4]

Digging-stick with weighted handle. (Map 32). As mentioned by Medina, Nuñez de Pineda y Bascuñan[5] relates, that the Araucanians (10), like the Bushmen, used digging-sticks in the upper part of which a perforated stone was fixed. His description is so explicit that there cannot be the

[1] *Montell* (1).

[2] *Krickeberg*, (1).

[3] »De armas defensivas no usan todos infantes, así como de las ofensivas, porque cuando mucho las traerán la quinta parte de los que se congregan en una junta. Las que traen son coseletes, capacetes i adargas, todo de cuero duro i crudio. Algunos de los coseletes son cortos como cueras, i otros mas largas i cumplidos. Por maravilla trae todas estas armas un soldado solo, porque unos traen mas i otros ménos de sus dife rencias; pero de las que mas usan son las adargas . . . Aún se ven algunos armados, aunque raros, de coseletes de barba de ballena que resisten las flechas, formados de tabla de anchura de una mano, cosidas unas con otras, de manera que vienen a ceñir el cuerpo i hacer forma de coraza, aunque no mui apretada.» (See *Medina*, p. 130.)

[4] (2), p. 107—108.

[5] p. 192. »Llegamos todos a la cumbre, donde algunos principiaron a hacer el hoyo con tridentes, palas y azadones; los tridentes son a modo de tenedor, de una madera pesada y fuerte, y en el cabo arriba le ponen una piedra agujereada al propósito, para que tenga mas peso, y con este van levantando la tierra para arriba.» —

slightest reason for doubting Bascuñan's statement. Stone rings that might have been used in this way have been found in many places in western South America and the southernmost part of Brazil. It is nevertheless certain that stone rings of this kind have also been put to other uses. They have served for club heads and also as net-sinkers. As a rule it may be presumed that the club heads were of better workmanship than those which were mere weights for digging sticks. It is not impossible that the original use of stone rings was for weighting digging-sticks, and that these, like, e. g., the digging-clubs of the Tsirakua Indians, as occasion demanded, did service as weapons. The net-sinkers are as a rule recognizable by the hole being excentrically placed. Kroeber[1] supposes that the Chumash Indians of California also possessed similar digging-sticks weighted with stone rings. In this we find yet another parallel between western North America and southern South America.

Fig. 10. Wooden spade from Nazca, Peru. 1/6. G. M. 21.2.29.

The wooden lump at the end of the handle that the Indians of Peru (A),[2] fig. 10), northern Chile (316)[3], and northern Argentina (D. E.)[4,5] used on their small wooden spades or digging-sticks, naturally served the same purpose as the stone rings on the Araucanian digging-sticks.

Eric von Rosen,[6] in his excellent treatise on the archaeology of the Tarija Valley unaware of Bascuñan's work endeavours to explain the stone rings there discovered by him as weights for digging-sticks.

[1] (2), p. 563.

[2] G. M. 21. 2. 29. From Nasca.

[3] *Montell* (1), fig. 28.

[4] *v. Rosen*, fig. 200—201.

[5] *Ambrosetti*, (1).

[6] *v. Rosen*, p. 355—357.

APPENDIX 2.

Ancient Inca lacquer work.

From the ancient Inca dominion I am only acquainted with two classes of Indian lacquered wooden articles. One of these consists of spades or paddles, staves, etc., found in the desert sand at Ica, on the coast of Peru. A spade or paddle of that kind is here depicted on Pl. 2, and on this specimen the bird figures are both coated and inlaid with lacquer. In addition, both sides of the blade are inlaid with a check pattern of red lacquer in two regularly alternating shades, one lighter and one darker. An analysis made by Dr. Almström of the former reveals that it contains cinnabar. In another of these articles Dr. Almström has established the presence of orpiment. The Indians used this substance for producing a yellow tint.

To the second category of ancient Inca lacquer-ware belong the well known wooden cups, "kerus", that are carved in one piece out of some kind of hard wood. From Professor A. Posnansky of La Paz, the Gothenburg Museum has received as a present one of these lacquered cups (Pl. 3,2) while two more have been presented to it by Consul-General G. Sandström. Professor Posnansky has further deposited five similar cups with the Museum, three of which at least are in a most beautiful style.

A number of this kind of lacquered cups have been recovered on the islands in Lake Titicaca, in the neighbourhood of Cuzco and elsewhere, under conditions contributing to their good state of preservation. Part of the cups date from the time before the Conquest, others were

made during a later period. On these the lacquer is applied in the same way as on the wooden articles from Ica, referred to above. The wood is engraved with figures subsequently filled with lacquer which, according to Posnansky, is coloured with lead oxide, antimony oxide, ferrous oxide, finely ground turquoise and malachite, finely washed kaulin, etc.

At the Museum für Völkerkunde in Berlin, a lacquered *keru*, or cup, of this kind is found, ornamented with figures representing a battle between mountain Indians armed with slings and forest Indians armed with bows and arrows. It was found in a grave at Ollantay, near Cuzco.[1] Representations of other wooden cups have been published by Hamy, Posnansky, Jijón y Caamaño, Carlos M. Larrea, and others. The wellknown Swedish archaeologist, Eric Boman, has found a lacquered cup of this kind in a grave at La Paya in northern Argentina.[2] This object was discovered under conditions which almost certainly point to its being pre-Columbian. It is lacquered in three colours. From the description it appears that the cup was lacquered all over, the lacquer thus not having been inlaid into figures incised in the wood as on the cups possessed by the Gothenburg Museum and the wooden figures found at Ica on the Peruvian coast. The La Paya cup dates — so far as can be judged by the ceramic finds of the same burial-ground — like the abovementioned lacquered wooden articles from Ica, from the time of the Incas. Thus we see that in western South America the knowledge of lacquering wooden objects extended all the way from Ecuador to northern Argentina.

An excellent description of a lacquered cup from Tisaleo in Ecuador has been given by Jijón y Caamaño[3] and Carlos M. Larrea. It is made from the wood of the guayacán tree

[1] *B(astian)* Zeitschrift für Ethnologie. Band IV. Berlin 1872.

[2] p. 233, fig. 17.

[3] 2, p. 41.

(Guajacum officinale.). The inlays consist of lacquer in six different colours: yellow, light-green, dark-green, light-brown, red, and black. The resin from which the lacquer was prepared had been obtained by the Indians from a plant known as mopa-mop.

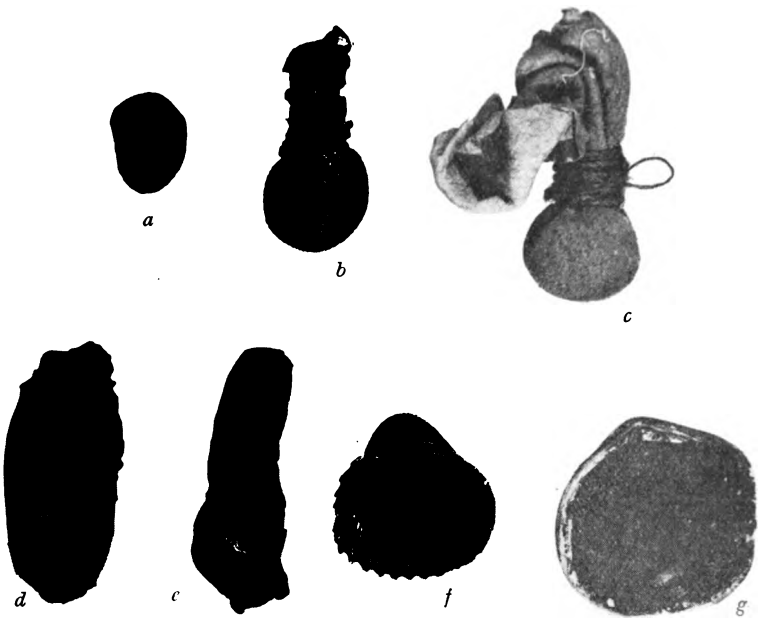


Fig. 11. Part of a lacquerer's set of equipment found in a grave at Ica on the Peruvian coast. G. M. 29.32.20. ½.
a. cinnabar; b, c. leathern bags containing cinnabar; d. black lacquer; e. red lacquer; f, g. colour-saucers of mussel shells.

Of the very greatest interest to the study of the Peruvian Indians' lacquer industry in pre-Columbian times is a find made by the late Doctor Gaffron in a grave at Ica on the Peruvian coast. It consists of a lacquerer's set of equipment and comprises a collection of leather bags containing colour-stuffs, colour-saucers of mussel shells, calabashes, lumps of black and red lacquer, etc. (fig. 11). Among the calabashes there is one carved with a number of figures which presumably were intended to be filled in with lacquer.

Dr. Almström has analyzed these colours and, among other things, found several of them to contain cinnabar.

It seems a debatable point whether the Incas were acquainted with metallic mercury. We have no direct evidence that this metal was known to them, but it is difficult to explain by what method certain pieces of silver-plating were achieved without a knowledge of amalgamating. Rather curious is Garcilasso de la Vega's[1] statement that prior to the Discovery the Incas had known mercury, but that the use of this metal was considered to be unhealthy and therefore forbidden, so that in the end it became forgotten. It is therefore very interesting when we find that the Indians of the Peruvian coast used cinnabar when they wished to prepare a beautiful red lacquer. In doing this they must have heated the lacquer, and it is possible that on some occasion a higher temperature was then applied than what was necessary, i. e. about 357°C, and that thereby mercury was inadvertently produced. If the Indians knew mercury, they could hardly have failed to notice its action on gold and silver. Among the lacquerer's paraphernalia there are — perhaps by mere chance — a few small pieces of sheet gold. If painting clay vessels with cinnabar was attempted, a higher temperature than 357° C must have been reached at their burning.

The Indian lacquerer's collection of colours includes several shades of red. Thus cinnabar has been mixed with gypsum and some glutinous substance to produce brick-red, and with a very dark-coloured sand to obtain dark-red. A pale shade of rose has been obtained from powdered limestone.

Realgar has yielded orange, and orpiment yellow. Both of these minerals are extremely poisonous arsenical compounds, so with all due regard to Garcilasso de la Vega's statement it may be taken as unlikely that the Inca craftsmen were hampered by any "Dangerous Drugs Act."

[1] Vol. 2, p. 413.

Dark green has been obtained from hydrous carbonate of copper (malachite). The collection further includes a small bag containing a greyish-green colour which, when analyzed by Dr. Almström, was found to consist of exceedingly finely powdered obsidian, i. e. native glass.

Ready-made lacquer, wrapped in leaves, forms part of the collection, both black and two shades of red. What kind of resin was used in the preparation of lacquer cannot be determined as the Indians were acquainted with a very large number of varieties.

I have already mentioned how Dr. Almström found that on the lacquer-inlaid spades and other wooden articles from Ica a beautiful red lacquer is colured with cinnabar while the yellow colour is derived from orpiment. On these articles are besides found traces of lacquer of ultramarine colour.

The wooden cups are interesting not only as specimens of Indian lacquer-ware but also on account of the figures in various colours with which they are ornamented. On one of the cups (see pl. 3) presented to our Museum by Prof. Posnansky a hunting scene is depicted. An Indian is seen preparing to sling a stone at a deer which is turning its head. The lacquer inlays on this cup are in cinnabar red, yellow, greyish green and brown.

On the above mentioned cups from the neighbourhood of Cuzco, which are to be seen in the Museum für Völkerkunde in Berlin, there is, as already mentioned, represented a scene depicting a battle between Inca Indians armed with slings, and forest Indians. The weapons of the latter consist of bows and arrows. On one of Professor Posnanskys'[1] cups there is depicted a scene which evidently represents Inca warriors returning with one of the abovementioned forest Indians as their prisoner. The Inca, or chieftain, is sitting on a low stool holding before him a long-handled battle-axe and a rectangular, ornamented shield. Opposite the Inca, a woman is sitting with a

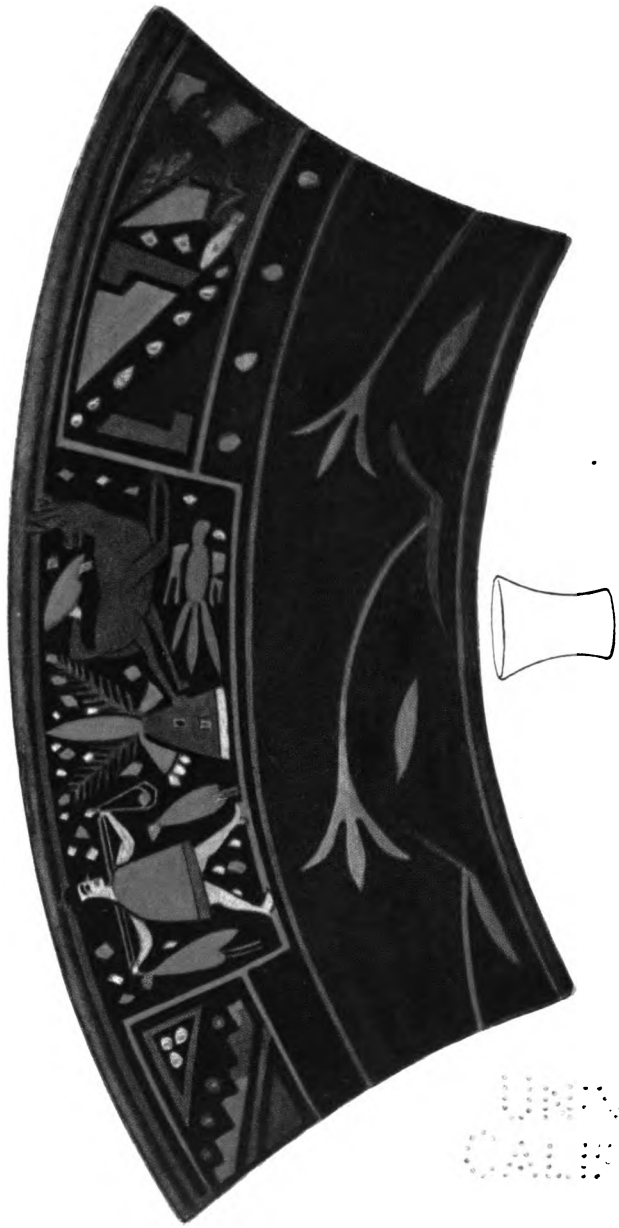
[1] El origin de la Bandera de Bolivia. El Diario 5 de Octubre 1930.

flower in her hand. Behind him is standing a hunchbacked man, and he, too, is carrying as a sign of rank a feather parasol over the head of the Inca. There are further seen two warriors, both with shields, one of whom is carrying a studded mace while the other is armed with a sling, in the act of bringing before the Inca a man whom they are leading by a noose laid round his neck. The complexion of the latter is in the lacquer reproduced in a darker tint than in the rest of the figures. Above the head of the prisoner is seen a monkey, symbolizing that he is a forest-dweller.

If we study the details on all these cups we shall find that they are all of them ethnographically correct. The ornaments on the dresses are identical with those we can see at the museum on clothing recovered from graves on the Peruvian coast or in drawings dating from the time of the Discovery. The feather parasols are indubitably quite correctly delineated. Somewhat foreign to Indian culture may the flowers appear to us the beautifully conventionalized [illegible] but we ought to bear in mind that plant ornaments [illegible] by no means unknown in the Inca realm. [illegible] related from there, as we know, about the [illegible] Cuzco, the capital city, that there were plants [illegible] and silver, and if we study the Peruvian textile collections at the Gothenburg Museum we shall find many weavings ornamented with flowers.

Notwithstanding the figures on the wooden cups being ethnographically correct, it is however possible that even those which represent scenes of Indian life from the Inca time were executed after the discovery af America, although in that case from ancient prototypes. The lacquer technique dates from pre-Columbian times, as is apparent from the grave finds mentioned above. I know of no lacquered object of pre-Inca time.

1. Spade or paddle. Ica. Length 210 cm. G. M. 21.2.23.



2. Lacquered wooden cup from Tiahuanaco ½. G. M. 28.3.31.

APPENDIX 3 a.

Ancient Colombian tools of gold alloy (Au—Ag—Cu).

In his treatise on the ancient population of the province of Antioquia, published in 1871, Andres Posada Arango relates of the discovery of chisels made of gold alloyed with copper. These tools he considers, citing the Italian, Codazzi and the Swede, v. Greiff, as having been used for engraving in stone.[1] Codazzi's geographical work on Colombia was forbidden by the authorities and much of it destroyed. Partly it has been published by Felipe Perez. Von Greiff's paper is not, so far as I have been able to ascertain, to be found in any Swedish library, but his diary is in the possession of the Misses Osterman, of Lund. It was published in the Lunds Veckoblad in 1827. A second diary is with his grandson, Senator de Greiff, of Bogota, in whose home Legation Councillor A. Winquist has seen it.

Posada Arango's paper was published a couple of years later in French, with illustrations, and in it is depicted one of these tools of gold alloy.[2]

In a treatise printed in Melbourne in 1859 another Swede, P. Nisser — whose works are very little known, and, from what I have seen, never quoted in the subject literature[3] — depicts one hoe (fig. 13), one chisel and two awls (fig. 14) of gold alloy from the Antioquia district. In this work 37 other golden articles from the same region are depicted. Of the

[1] (1) p. 11.

[2] (2) Fig. 119.

[3] To Mrs. Rosa Nisser Andersson I am greatly indebted for the able assistance she so kindly has rendered me in my search for the publications of her relative, Mr. P. Nisser.

gold alloy tools Nisser says that they are found in graves, although not frequently.[1] Nisser has also written a small book on ancient and modern Indian gold mines, which contains much interesting information. It was published at Stockholm in 1834.

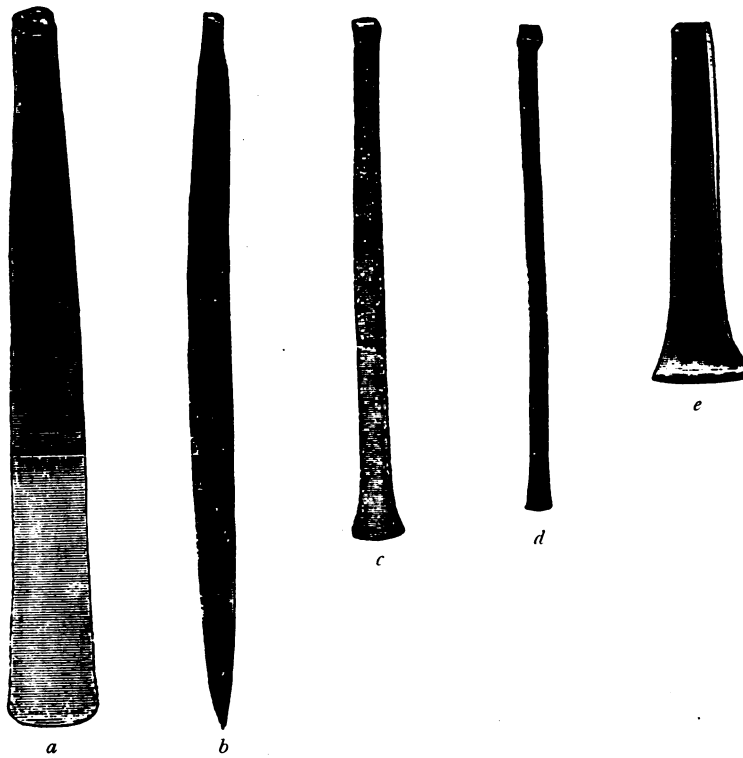


Fig. 12. Chisels of gold (probably gold alloy) from the District of Carolina, Antioquia. Colombia. b. side view of a. Natural size. (After Bryce-Wright).

Nisser's collection, with the exception of three objects, was in 1863 presented by himself and M. Ferdinand Mueller, of Melbourne, to the National Museum at Copenhagen. By courtesy of M. Th. Thomsen, Inspector of that Museum,

[1] "Implements for smelting gold, and some tools made of gold and copper are sometimes, though but rarely, found in the pot occupying the niche". (1) p. 7.

the Gothenburg Museum has been allowed to acquire, through exchange, one of the awls and to borrow the hoe-blade for examination. To these objects I shall refer later.

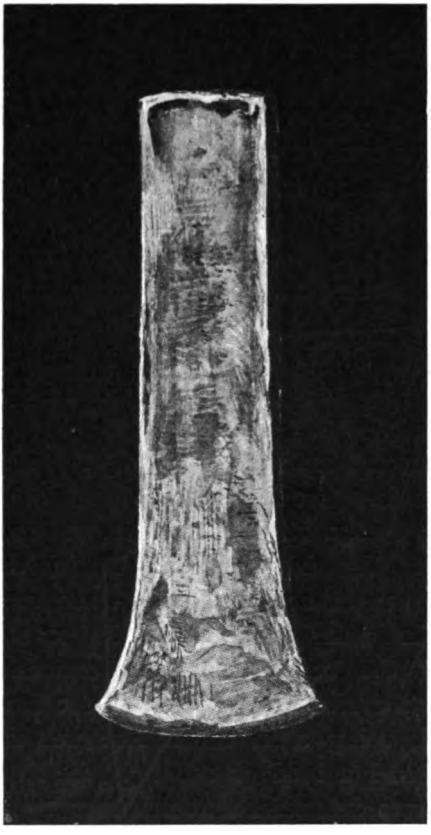


Fig. 13. Hoe of gold alloy from the Antioquia district in Colombia. Original in the National Museum at Copenhagen. 1/1 A. 703.

In 1885 a well illustrated treatise written by Bryce-Wright was published in London, as an appendix to a small Exhibition catalogue, in which is described a collection of golden ornaments, etc., from the Antioquia district, the property of Lady Brassey. The collection I understand is

now found at Hastings. Bryce-Wright writes: "The collection, although not containing many implements, is extremely rich in possessing examples of chisels."[1] Four of these chisels are here reproduced from Bryce-Wright's treatise (fig. 12).

Mr Bryce-Wright says that the implements described by him are of gold and hardened by hammering. They do not appear to have been more closely examined either as regards the hardness of the metal or its composition.

In Ernesto Restrepo Tirado's treatise, "Los Quimbayas", mention is also made of golden chisels of various sizes, one of which is depicted.[2] In the Museum für Völkerkunde in Berlin there is, according to what I am informed by Professor Krickeberg, a similar chisel of gold alloy, catalogued V. A. 2098. It is between 14 and 16 carats, and, according to micro-chemical analysis made by Dr. Brittner, contains copper.

The awl above referred to (G. M. 30.9.1), which the Gothenburg Museum has acquired from Nisser's collection, has been analyzed by Dr. K. G. Almström, and found to contain 33 % Au, 12 % Ag and 55 % Cu. This is the composition generally known in archaeological literature as tumbaga or guanin. In order to ascertain its practicability as a working tool the bodkin has been examined by Mr. A. Hultgren, of Söderfors. He tested it for hardness by Brinell's method, using a so called Rockwell machine with a ball of 1/16″ and a load of 100 kg. (the Rockwell B-test). Its hardness was determined at numbers 170 and 180, Brinell's scale. After red-heating, the degree of hardness was reduced to 155, which proves the metal to have been cold-worked. Mr. Hultgren has also tested a composition synthetic to that of the bodkin, and ascertained that its hardness when cast was 114, cold-hammered 216—229, and,

[1] p. 213.

[2] According to the letter-press. The accompanying illustrations I have not seen.

after heating, 140. It is evident that the bodkin was cold-hammered, although not sufficiently for producing the greatest possible degree of hardness.

The hoe-blade, mentioned in the foregoing, has also been analyzed by Dr. Almström, and found to consist of Au 38.4, Ag 12.6 % and Cu 49. Its hardness has been tested by Mr. Hultgren by the same method as employed in the case of the bodkin, and ascertained to vary from 150 to 203, Brinell's scale. Also this article has apparently been subjected to cold-hammering, although the hammering in different portions of the blade has varied considerably. Unfortunately the test applied to the edge, the part where the greatest hardness might have been expected, was unsuccessful. The number 203 was arrived at on the side of the blade that evidently had been intensely cold-hammered.

No closer examination of the effect of the cold-hammering upon the hardness of the metal was however carried out, as we did not wish to subject the beautiful hoe-blade to heating.

From these tests, of which Hultgren gives an account below, we see that the tumbaga tools were of a hardness of even up to 203 in the Brinell scale. Tools of this alloy were considerably harder than those Peruvian ones of pure copper that have been tested by Hultgren, even after the latter had been cold-hammered. They are fully comparable with, if not superior to, the bronze tools that were used in the Inca realm. The greatest degree of hardness ascertained by Hultgren in his tests of the American bronzes in the Gothenburg Museum was 150, obtained with a ball of 2.5 mm. and a load of 190 kg. This was in an axe composed of 86.47 % Cu and 13.42 % Sn. After heating, the hardness of this piece equalled 76.

Thus we have ascertained that the Indians of the Antioquia district possessed tools made of silver-mixed gold alloyed with copper. The latter metal was to them, in

certain regions at any rate, obtainable in its native form although strangely enough they never (or rarely?) used it unmixed for the manufacture of tools. It is evidently only after they learnt how to mix copper with gold that they conceived the idea of using metal tools.

It is possible that tools of gold alloy were also possessed by the Indians on the Mexican coastland that was discovered by Juan de Grijalva. In Gomara's list of the costly articles Grijalva had obtained from the Indians by barter are included forty axes of gold mixed with copper, together worth 2,500 ducats.[1] The number of the axes being so great indicates that they were tools very commonly used, and the high value at which they were assessed proves that there could have been no confusion with bronze. As in Colombia, these Indians also possessed fish-hooks made of gold. Of these implements Grijalva acquired twenty by barter.

I also think it probable that the Indians of the Antioquia district became acquainted with bronze tools of some sort or other of those used in the Inca realm, obtained by them somehow in the course of trading with their southern neighbours, and that they imitated these tools in tumbaga, i. e. an alloy of gold and copper.

In looking over a collection of analyses of golden articles from Colombia one may at first receive the impression that the silver-mixed gold was alloyed with copper in more or less haphazard proportions. But then it must be remembered that the analyzed objects date from *different periods* and originate in *different regions*. If we consider Rivet's collocation of analyses of golden objects from the Antioquia district together with the analyses that have been made in connection with the present treatise, we shall think differently. We shall find that in the majority of the analyzed objects copper enters in a proportion of from one-half to one-third. If we then also take into consideration the uses for which the different implements

[1] *Gomara*, p. 299.

were designed, it will be evident that the proportioning of the different metals was not done at random. There is moreover the circumstance that all the objects are probably not contemporary.

As a result of this little investigation we have discovered the fact that in a limited part of Colombia the Indians in pre-Columbian times lived in — if we may call it so — a tumbaga age, seeing that their implements were made of a metal composed of silver-mixed gold and copper. Those bodkins, chisels and hoes, of tumbaga, are, as the tests for hardness have proved, equally efficient as the corresponding tools from the Inca realm.

At the time of the Discovery the Indians of the Inca dominion, as we have seen, lived in a bronze age, and in Mexico, as has been shown by Rivet, the knowledge of bronze had shortly before the Discovery been acquired from Peru. In eastern North America the Indians very largely lived in a copper age, that is to say they were unacquainted with the art of smelting copper, but cold-hammered it in its native state.

In parts of western Colombia the Indians lived in the tumbaga age, and in the rest of America in the stone age.

We know that in the Inca realm the bronze age was preceded by a copper age. The tools made of copper were cast in a mould. Here the art of smelting copper was known. The great problem is now this: Was this South American copper age, in which the art of smelting and casting copper was known, preceded by a copper age like that of eastern North America where, it is true, copper was used in the manufacture of tools, but where the tools were shaped exclusively by cold-hammering?

APPENDIX 3 b.

The hardness of Columbian tools made from Copper-Gold-Silver alloys.

By

AXEL HULTGREN.

Professor E. Nordenskiöld, of Gothenburg, submitted for investigation an *awl* from the Antioquia district of Colombia, marked 30. 9. 1, from the ethnographic collection of the Gothenburg Museum, with the object of testing its hardness and of finding out to what extent its hardness had been increased by cold-working.

The appearance and dimensions, in millimetres, of the awl are given in fig. 14. The surface was full of cracks, mainly transverse. At AB near the blunt end a sample had been taken for chemical analysis by Dr. G. K. Almström, Gothenburg. The following composition of the interior solid portion of the awl was reported by Dr. Almström:

Copper	55 %
Gold	33 %
Silver	12 %

For hardness testing the diagonal plane AB was polished. The test was carried out in a Rockwell machine, using a 1/16″ steel ball and a load of 100 kg — Rockwell B combination. The hardness number was then computed according to the Brinell scale by dividing the load in kilograms by the area of impression in square milimetres.[1] Two tests

[1] The hardness numbers obtained, owing to the high ratio $\frac{\text{load}}{\text{ball size}}$ are some what higher than those of the standard Brinell combination: 3 000 kg load and 10 mm ball.

were made along the centre line of the diagonal area. The Brinell hardness numbers obtained were 180 and 170.

The awl was then annealed for 10 minutes at 500°C, whereupon the hardness was found to have decreased to 163. A second annealing was carried out in the same manner. The hardness had then decreased to 155.

In order to demonstrate further the significance of the hardness numbers obtained on the awl, Professor Nordenskiöld had a synthetic alloy of the same composition — copper 55 %, gold 33 %, and silver 12 % — prepared. The melt had solidified in the form of a cake as shown in fig. 2.

A slab 5 mm wide (C fig. 15) was detached from the cake by sawing, and filed to a uniform thickness of 3.8 mm. The slab was cold-hammered flat on an anvil into a wedge-shaped piece. The hardness was tested on the undeformed slab, as well as on portions of it which had been reduced various amounts by hammering. The slab was then successively annealed at increasing temperatures, the hardness being tested after each annealing. The following results were obtained:

Annealing condition	Brinell Hardness			
	Unhammered 3.8 mm thick	Hammered to a thickness of		
		2.7 mm	2.0 mm	1.0—0.5 mm
Unannealed	114	221	216	229
Annealed 500° C 10 mins.		146	153	157
Annealed 600° 10 mins.		144	144	147
Annealed 700° 5 mins.		135	137	140
Annealed 750° 5 mins.	115	140	141	142

A second slab 3.5 mm square (D fig. 15) was prepared by sawing and filing. Slab D was cold-hammered by steps on both faces, tested, annealed, and tested again. The results were:

Annealing condition	Brinell hardness after hammering to	
	3.0 × 3.0 mm	2.5 × 2.5 mm
Unannealed	176	179
Annealed 500° 10 mins.	156	156
Again annealed 500° 10 mins.	144	148

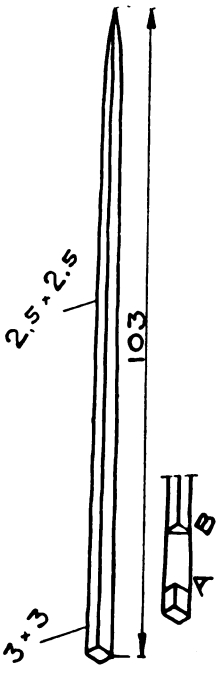


Fig. 14.

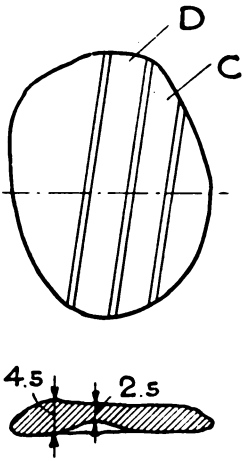


Fig. 15. 1/1.

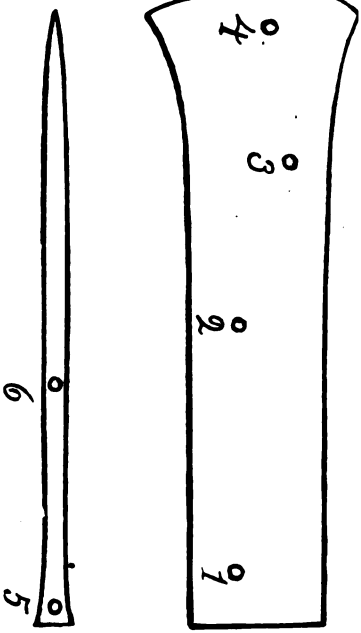


Fig. 16. 1/1.

Fig. 14. Awl of gold alloy from the Antioqua district in Colombia. 1/1. G. M. 30.9.1. Fig. 15. Slab of a synthetic alloy of the same composition as the awl (fig. 12). Fig. 16. Hoe of gold alloy from the Antioquia district in Colombia. original in the National Museum at Copenhagen. A. 703.

Thus, in this case, the greatest hardness attained in cold-hammering was not as high as in the experiment with slab C. Probably a greater amount of reduction would have increased the hardness of slab D still further.

The hardness of a *hoe* from the collection above mentioned was also examined.

The hoe is shown in fig. 16 in natural size. The composition, as determined by Dr. G. K. Almström in Gothenburg, was:

Copper	49 %
Gold	38,4 %
Silver	12,6 %

The hardness was determined at various points on the flat side as well as on the edge, as shown in fig. 16. The test was made in a Rockwell machine, using a $^1/_{16}$″ steel ball and a load of 100 kg. The hardness number was computed according to Brinell. The results were:

Point (Fig. 1.)	*Brinell Number*
1	161
2	150
3	174
5	203
6	191

The test at point 4. failed because the surface contained numerous cracks.

CONCLUSIONS

From the experiments made with slab C of the synthetic alloy it is seen that the Brinell hardness as cast was 114, as cold-hammered, 216—229, as cold-hammered and fully annealed, about 140. A worked object of this composition would, therefore, be expected to have a hardness between 140 and 230, depending upon the degree of cold-work it had received.

The awl, in being hammered into shape, had been cold-worked, which is indicated by the fact that the hardness, on annealing at 500°, fell from 170—180 to 155. The maximum degree of hardening by cold-work possible had not, however, been attained. It seems not unlikely that the

blank of metal used for forming the awl was first hammered hot. Owing to its small size it would cool rapidly during hammering and, possibly, had to be reheated for further hammering. At any rate, in the final hammering operation, the awl had either been hammered in the cold state, or else during hammering had cooled to such low temperatures that hardening from cold-working resulted.

The results of hardness tests made on the hoe indicate that the latter had also been hammered in the cold state.

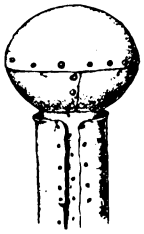


Fig. 17. Handle of wooden spade (?) covered with thin silver plates affixed to the wood by means of bronze nails. 1/4. G. M. 21.2.8.

APPENDIX 4.

On the occurrence of metal nails in South America.

As a culture element, the nail may not seem to be of much account, but such is by no means the case. On the contrary, it is undoubtely an exceedingly important invention, one which in certain parts of America supplanted the process of joining by stitching or glueing. To me it is of especial interest to point to the occurrence in South America of a culture element like the metal nail because *I am of the opinion that we should rigorously guard against limiting all comparisons to some few universally known culture elements, but instead concentrate upon seeking out all inventions that were known to the Indians of the pre-Columbian era.*

Metal nails dating from pre-Columbian times I only know from Ica on the Peruvian coast, in which case thin plates of silver or copper were affixed to wood by means of bronze nails (fig. 17). These nails are 2 to 6 mm. long and lack a distinct head.

Dr. Almström has analyzed nails of this kind taken from two different objects. On account of the smallness of the nails he had to use a number of them for each different analysis. For the first analysis the nails were taken from an ornamented staff, G. M. 21. 2. 44. The analysis showed 18% of tin and 82% of copper. For the second analysis the nails

were taken from a paddle, G. M. 21. 2. 47, and here they were found to consist of 3% of tin and 97% of copper. Evidently the proportion of tin in these nails varies considerably.

Metal nails of Indian manufacture are unknown to me from any Indians now living. Even where Indians nowadays are able to obtain nails from the whites they seldom put them to the use for which they are designed but only for arrow-heads, bodkins, and the like.

Wooden nails are very rarely used by Indians. Nails of this kind I only know from the Chacobo and Chocó Indians. The former use them for nailing together a sort of seats made from palm-leaf stalk and from palo balso — a very light and soft kind of wood — and the latter use wooden nails principally for fastening together their medicine huts which are constructed from the kind of wood just referred to. Both the Chacobo and the Chocó Indians use nails made from hard palm wood. A kind of very long wooden nails are used by the Chimane, Mosetene and others for nailing together their rafts made from palo balsa. These appliances are however more of the nature of transverse slats than nails. The Chacobo, Chimane and Mosetene are tribes inhabiting Bolivia, while the Chocós are settled in the Istmus of Panama and neighbouring tracts of Colombia.

Whether the use of wooden nails originally is an Indian notion or something they have learnt from the whites I cannot tell. As to the Chocós, their contact with whites and negroes dates back for centuries, while on the other hand the Chacobos have always been living in a very isolated state. The Mosetenes and the Chimanes have also been strongly influenced by the culture of the whites. All this does not, however, prevent me from taking it for granted that this method of connecting together the logs of the rafts by means of long wooden nails or slats is an Indian invention seeing that these contrivances are very rarely, if at all, constructed by the whites.

APPENDIX 5 a.

Notes on some archaeological whistling arrow-heads from Peru

by

STIG RYDÉN.

In the course of a visit to the Roemer Museum at Hildesheim the object here reproduced in fig. 18 happened to attract the attention of the author. This object consists of a copper rod 21.5 cm. long, with a hollow bulging portion just behind its centre. The solid and longer part in front of this is nearly circular in section, while the cross-section of the portion just behind it is shorter and approximately square. The locality where this object was found is given as Pindillig in Ecuador, and in the Roemer Museum it is catalogued as a spindle. Pindillig is probably identical with the place known as Pindilic, near Taday, where was found a clay vessel an account of which has been published by Rivet and Verneau in their important work on Ecuadorian archaeology[1], and is also presumably the same as the Pindeling mentioned by de Rochebrune[2] as the finding-place of certain pieces of shell-work.

Certain exterior points of resemblance to the whistling arrow-heads that are used among the Goajiro Indians (fig. 19) made me, on closer examination, arrive at the conclusion that here was a whistling arrow-head of a type hitherto unknown. The shorter portion of the rod — the tang —

[1] *Rivet* (8). Planche LI:12.

[2] *de Rochebrune*. Pp. 311—320.

Fig. 18.

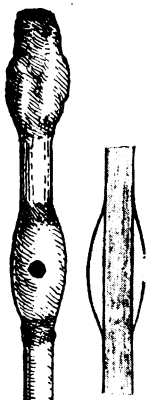


Fig. 19 b.

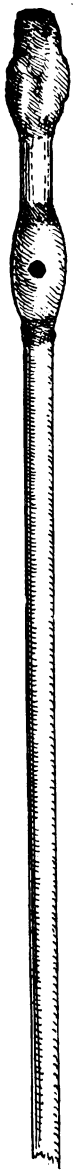


Fig. 19 a.

Fig. 20 a.

Fig. 20 b.

Fig. 18. Whistling arrow-head of copper. Pindillig, Ecuador. G. M. 31.12.1. 2/3.

Fig. 19 a. Whistling arrow with clump head of wax. Goajiro Indians. G. M. 24.2.322. About 2/3.

b. Cross-section of the whistle, consisting of some kind of cocoon.

Fig. 20 a. Arrow with clump head consisting of a nutshell. Kamayura. G. M. 29.19.88. (K. v. d. Steinen coll.) 1/2.

b. Cross-section of the arrow-head.

was covered with a waxy layer containing impressions of an irregularly made winding of thread, and in this waxy layer were also present fragments of fibre which Dr. G. Karl Almström has identified as consisting of cotton.[1] It is quite obvious that this shorter portion constitutes the tang of the arrow-head and also that it once was socketed in an arrow-shaft by means of wax. In order to secure the arrow-head firmly in its place it was found necessary to wind cotton thread round the tang, and thus the pieces of fibre, as well as the impressions in the waxy coating, would be attributable to this winding. The weight of the arrow-head is 62 grammes. This may perhaps appear rather heavy, but it may however be pointed out that among the Motilones one finds harpoon arrows with heads weighing as much as 55 grammes (G. M. 16. 3. 915). The whistling arrow-heads here dealt with may supposedly have belonged to arrows propelled by throwing sticks, in which case front-heaviness is desirable in view of the fact that arrows of this kind are generally unfeathered.

Superficial examination of the arrow-head revealed that on the hollow portion, opposite to the small aperture, a very fine seam was discernible. As there were reasons to believe that this seam was welded, and as a closer examination was not possible without some measure of damage being done to the object, the Gothenburg Museum subsequently contrived — by courtesy of the Hildesheim Museum — to acquire ownership of the arrow-head. It was thereupon handed over to Mr. A. Hultgren, with the request that he would kindly ascertain the manner in which the arrow-head had been manufactured, an examination which in its turn led to the discovery of a Peruvian soldering technique hitherto unknown.[2]

From Dr. E. Gaffron the Gothenburg Museum has received as a present two whistling arrow-heads which, however, are

[1] See Analysis 2, p. 121.

[2] See Appendix 5 b, p. 123.

not in such a good state of preservation as the one mentioned above.

The finding-place of these latter arrow-heads is the coastland of Peru, possibly the Hacienda de Sa. Clara, as in Gaffron's collection they were packed together with other objects originating from the same locality. One of these arrow-heads (G. M. 30.28.53) is 13 cm. long and roughly corresponds to the one from Pindillig mentioned above. Thus the portion of the rod constituting the point is round in section, while the tang is very nearly square. On the tang, in the crust resulting from oxidation and weathering, it is possible to discern impressions from thread-winding.

The second of the two arrow-heads (G. M. 30. 28. 54) is in a very bad state of preservation. Probably on some occasion it has been exposed to very fierce heat and thereby become in part deformed. It presents a special point of interest in the manner in which it was fixed in the arrow-shaft. In analyzing metal particles from the surface layer of the tang, Dr. Almström among other things established the presence of sulphur in proportions up to 19.2 %.[1] He considers that, because of this sulphur-carrying surface layer being confined to the tang proper, the arrow-head was fixed in its reed shaft by means of molten sulphur in the same way as in our days iron rods, iron railings, etc., are anchored in stone. In order to test the material strength resulting from cementing in this manner an arrowhead of copper in a reed shaft the author carried out the following experiment:

As in all the arrow-heads examined in the present instance the tang, judging from impressions discernible on its surface, was originally wound with thread, I wound some cotton thread in a similar manner round a copper rod. A piece of reed corresponding to the arrow-shaft was then filled with molten sulphur and into this the copper rod was inserted. When the sulphur had set I was surprised to

[1] See Analysis 3, p. 121.

find how firmly the copper rod was fixed in the reed shaft. In order to ascertain in what manner the sulphur acted on the copper, the whole thing was then broken up, and it was seen that the portion of the copper rod that had been embedded in the sulphur was slightly blackened on the surface. That the sulphur in this case had not combined as strongly with the copper as in the tang of the arrowhead from Hacienda Sa. Clara is probably due to the fact that the copper rod used in this experiment had not been exposed to fire like the arrow-head. For, as mentioned in the foregoing, it should be remembered that the arrow-head shows obvious signs of having been exposed to fierce heat, whereby the joint on the hollow portion as well as the shaft was spoilt.

Professor E. Nordenskiöld has pointed out to me that the Swedish explorer Eric Boman in his important archeological work makes mention of a couple of cramps used to hold together stone blocks in the walls at Tiahuanaco.[1] Boman fixes the proportion of sulphur in the two cramps that he has examined at 2.55 and 0.87 %, respectively, and considers that this may possibly be due to the metal of these cramps having been produced by the reduction of copper pyrites. It is more probable that the cramps in question were cemented in the stone with sulphur in the same manner as the arrow-head above mentioned was cemented. It should however be noted that the presence of sulphur was not established at the analyses that were carried out by Dr. Almström of two similar cramps from Tiahuanaco,[2] one of which[3] belonging to the Trocadero Museum in Paris is stated to be one of those that Boman subjected to examination[4]. Against this, however, may be set the fact

[1] *Boman*. T. II, p. 859 fol.

[2] See Analyses 4 and 5, p. 122.

[3] See Analysis 5, p. 122.

[4] To the director of the Trocadero Museum Dr. P. Rivet I am greatly indebted for the permission to examine and anelyse this cramp.

that that particular cramp bore no trace whatever of having been bored or scraped for obtaining metal for analysis. As will be apparent from the analysis, some sort of mortar seems to have been used for the fixing of this cramp.

The method of thus cementing iron objects with sulphur does not appear to have come into use in the Old World until long after the discovery of America. In the Old World, in ancient times as in the Middle Ages, in similar cases, it seems that lead was used, or instead very occasionally resin, although in the countries bordering upon the Mediterranean sulphur might have been obtained without any particular difficulty. It is possible that the spreading use of gunpowder eventually led to the invention of the method in the Old World.

As regards the occurrence of sulphur within the borders of the ancient Peruvian dominion it only needs pointing out that this substance is abundantly found in the Andean mountain region, all the way from Ecuador right down to Chile.

In his book "Modifications in Indian culture through inventions and loans",[1] Professor E. Nordenskiöld discusses the whistling arrow, and, from its distribution in America holds that it must have been invented in at least two different places. Friederici,[2] who latterly has adduced further material bearing on this subject, considers, by reason of this type of arrow occurring in eastern Asia, that its presence in America is due to Asiatic influence via Bering Strait. The real facts of this question are difficult to determine, though the possibility of the presence of the whistling arrow in North America being due to the influence suggested must be admitted. The whistling arrow may, however, have come into being by once, e. g., nutshells with natural holes having come in to use for the thickened head

[1] *Nordenskiöld* (8). Pp. 165, 244—245.

[2] *Friederici* (11). Pp. 352—362.

on bird-arrows. Among the Kamayura, for example, are used arrows — discharged by means of throwing-sticks — in which the thickened head consists of a nutshell designed to make a whistling or booming noise in its flight (fig. 20). In this connection it should be mentioned that Seler[1] has published a picture of a clay vessel from Nazca on which are reproduced some whistling arrow- heads, from which it is evident that these weapons were known in Peru long before the Inca period.

Analyses

made by Dr. G. KARL ALMSTRÖM.

1. Two samples of metal from the point and the tang of an arrow-head labelled G. M. 31.12.1 (fig. 18). Both samples proved to be free from tin and only consisting of copper.

2. As stated in the foregoing, the metal forming the point as well as the tang consisted of copper free from any admixture of tin. The tang was wound with some fibrous substance which on examination proved to be cotton fibres. The winding material also contained some waxy matter. The middle and hollow portion of the arrow-head likewise consisted of copper, but was coated with some yellowish-white metal which mostly formed an extremely thin film, but thickened slightly on the tapers bordering on point and tang, respectively. This yellowish-white metal proved to consist mainly of silver. Of this, it could not be shown that mercury formed a component. Neither the tang nor the point were coated in this way.

3. Whistling arrow-head from Hacienda de Sa. Clara (G. M. 30.28.54). One of the two narrower ends of the arrow-head was found to be encased in a coating of sulphur-copper.

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[1] *Seler* (2). Bd. IV, p. 334, fig. 421.

The metal forming the middle portion of the barrel contained:

Tin	0.6 %
Copper	94.4 %

The surface coating on the narrower portion consisted of:

Tin and insoluble substances	1.8 %
Copper	76.8 %
Sulphur	19.2 %
Other substances	2.2 %

A similar sulphur-copper coating is producible if heated copper is treated with sulphur.

4. A metal cramp from Tiahuanaco labelled G.M.31.13.2, (Buck coll.), which on being analyzed was found to consist of:

Copper	99,0 %
Slag	1.0 %

The coating that was present on the cramp was found to consist of sand and calcareous clay.

5. A metal cramp from Tiahuanaco, belonging to the Trocadero Museum in Paris, and labelled 08.23.3739.

Tin	1.0 %
Copper	99.0 %

APPENDIX 5 b.

Metallographic Investigation of a So-Called Whistling Arrow-Head of Copper.

By

A. HULTGREN and G. PHRAGMÉN.

From Professor E. Nordenskiöld, Gothenburg Museum, the authors received a so-called whistling arrow-head of copper from Pindillig in Ecuador with a view to ascertaining, if possible, in what manner it had been made.[1]

Fig. 21 shows the appearance of the arrow-head, as viewed from various angles. The front part, here called the point, was round and somewhat tapered towards the end. The back portion, or tang, had a square cross section, and was also somewhat tapered. The central part consisted of a hollow bulb, having a rounded, elongated, somewhat unsymmetrical shape, with gradual transition to point and tang. On one side of the bulb was a hole about 3 millimetres in diameter. The wall thickness of the bulb appeared to be about 1 millimetre. By inserting a piece of wire through the hole, an approximate idea of the inner contour of the bulb, as drawn in Fig 21, was obtained.

The point and the bulb were covered with a crust of green corrosion products. The tang had obviously been fastened by insertion into the body of the arrow. Textile fibre and a waxy substance, remainders of which were found adhering

[1] For further details on the origin of the object, see: Notes on some archaeological whistling arrow-heads from Peru by Stig Rydén, Published in this volume of Comparative Ethnographical Studies 115.

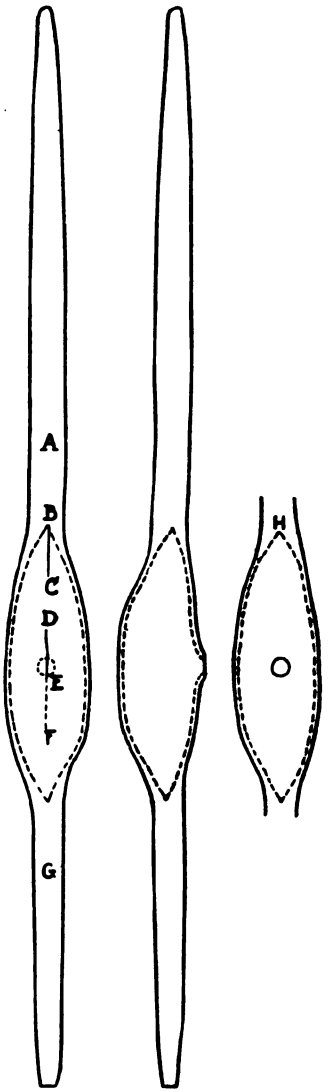

Fig. 21. Whistling arrow-head of copper Pindillig, Ecuador. G. M. 31.12.1. 2/3.

to the surface of the tang, were probably used for that purpose.

Small quantities of drillings and filings taken from different parts of the arrow-head had been analyzed by Dr. G. Karl Almström, Gothenburg, with the following results:

Drillings taken from the point at A and from the tang at G were found to consist of copper, free from tin. The bulb was also made of copper, with a thin surface-layer of a yellowish-white metal mainly consisting of silver. This was ascertained by analyzing filings taken from E. Presence of silver was also determined in filings taken at H, where the point joined the bulb.

On the surface of the bulb, which was otherwise fairly smooth, slight indications of a longitudinal joint could be seen at points between D and F. At D—E the surface was prepared for microscopic investigation by grinding with fine emery paper and finally polishing by alumina powder, using a moist piece of cloth. In the prepared area the joint was now distinctly visible at low magnification as a continuous narrow seam, as shown in Fig. 22 (×6, unetched).

On further examination at high magnification, it was confirmed that the bulb consisted of copper. The seam was largely filled with an alloy consisting of fine-grained

Fig. 22. Prepared area of bulb revealing seam. × 6.

silver-copper eutectic and rounded portions of copper, see Fig 23 (×1500, unetched). For comparison, the structure of an alloy containing 60 % silver and 40 % copper, as cast, is shown in Fig. 24 (×1500, unetched). The latter was obtained by melting a silver coin on a piece of asbestos in

an acetylene flame, with subsequent solidification in the air. The similarity between the structure of Fig. 23 and Fig. 24 is obvious. The red copper component of the eutectic,

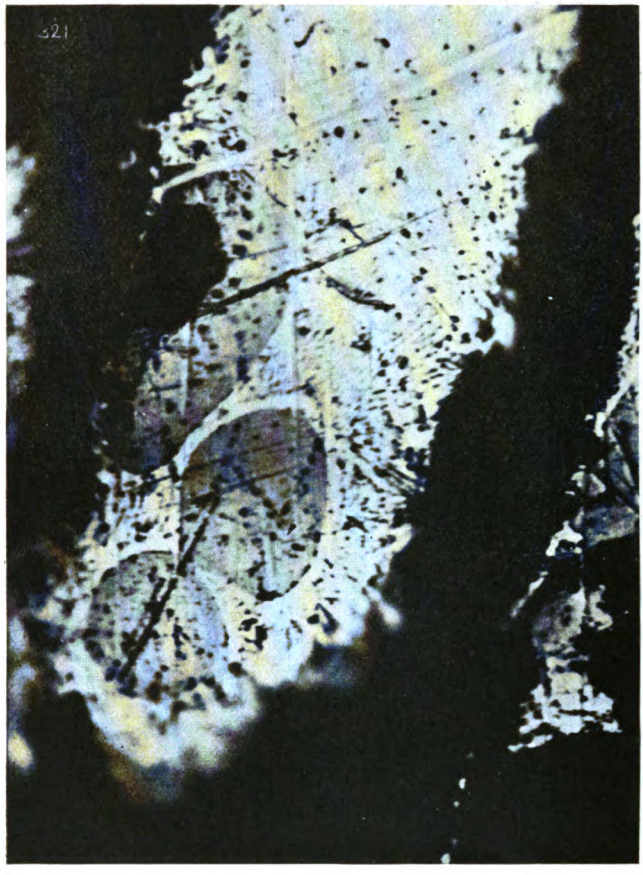

Fig. 23. Silver alloy in seam. Unetched. × 1500.

on the photos appearing as grey, has the form of fine threads embedded in a white silver matrix.

Patches of silver alloy were also seen in the prepared area at a distance from the seam. Beneath the thick crust of corrosion products and nearest to the copper was a film,

probably consisting of cuprous oxide. Near the surface, the copper component of the alloy was also oxidized. This is seen in Fig. 25 (× 1500, unetched) which was taken

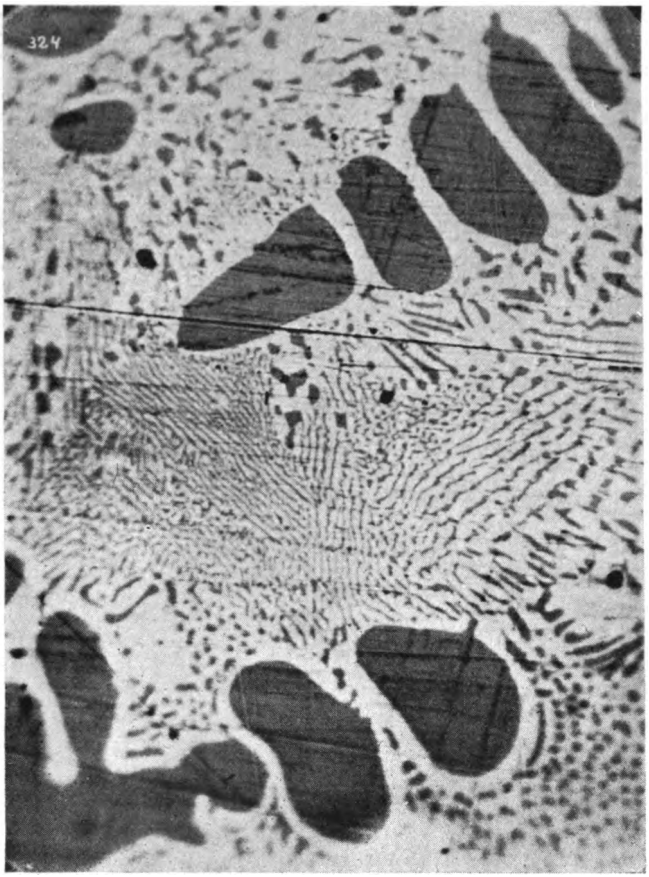

Fig. 24. Cast alloy, 60% silver and 40% copper. Solidified in air. Unetched. × 1500.

from one of the patches of alloy not connected with the seam. The rounded copper areas are here wholly converted into dark oxide. In some portions of the eutectic the copper threads are oxidized and dark, in the others the grey

tone of the threads indicates unoxidized red copper. Referring to Fig. 23, it is seen that one of the large copper grains has a dark patch of oxide.

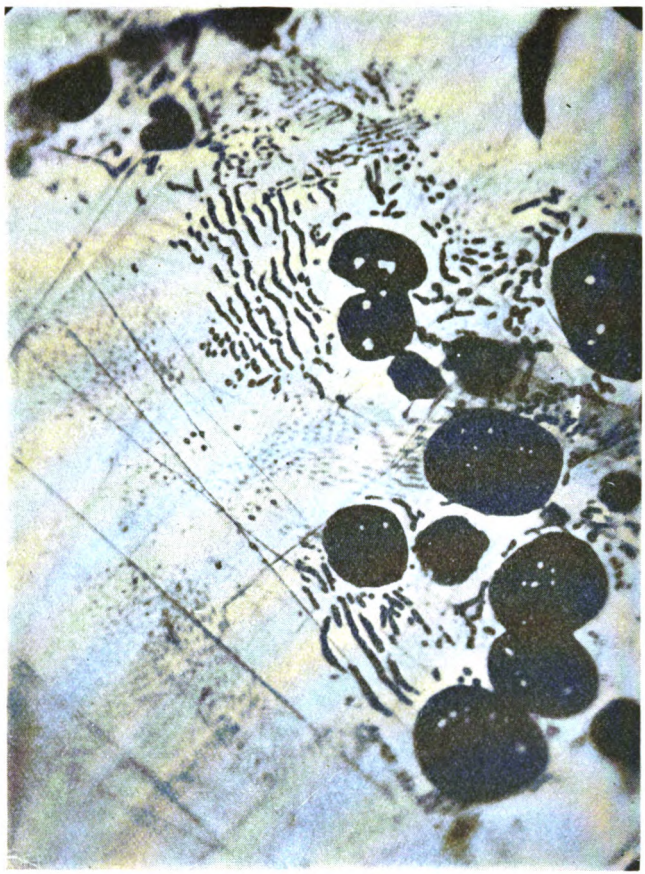

Fig. 25. Silver alloy on surface of bulb. Copper. Partly oxidized. × 1500.

In order to find out how the bulb was connected with the point, an area was also polished at BC. It was thus established that there was no joint between the bulb and the point, both being formed from the same piece of copper.

Furthermore, a continuous seam was revealed between B and C in line with D—E. The seam terminated at B. In the seam between B and C, silver alloy was also present.

CONCLUSIONS.

From the observations made may be inferred that the arrowhead was made from one piece of copper, which was probably treated in the following way. After hammering the piece into a rod, the middle portion was flattened out into a thin plate. In the centre of the plate a hole was formed, by piercing or drilling, and then the plate was bent into the shape of a bulb, so as to make both edges meet along a longitudinal seam. The bulb was then heated and the whole length of the seam soldered with either an alloy of silver and copper or silver alone. If the latter is true, the copper content of the alloy was derived from the bulb itself by partial dissolution in the molten silver. During the soldering operation, the molten alloy would wet the hot copper and spread around the surface of the bulb forming a more or less continuous film.

For comparison, Professor Nordenskiöld also submitted two other whistling arrow-heads from the Gothenburg collection. Both were similar in shape to the one described above, but smaller. One of these was in an advanced state of corrosion and could not be examined. The other was examined with the following result:

The arrow-head was made of copper. The bulb was in one piece with tang and point and had been formed in the same way as described above, a continuous longitudinal seam being visible opposite to the hole. Along half of the seam the edges overlapped. In this case, however, no trace of silver could be found in the seam. Probably this bulb had not been soldered.

The present investigation was carried out, by kind permission, in the Laboratory of Söderfors Steel Works, Söderfors, Sweden.

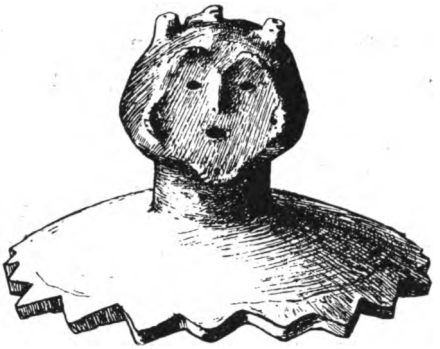

Fig. 26. A Neolithic ceramic object from the Pan-Shan group of Kansu (ca. × 1/4). After Bulletin of the Museum of the Far Eastern Antiquities, Stockholm.

APPENDIX 6.

Calabashes with star-shaped lids in South America and China.

By KARL IZIKOWITZ.

Among culture elements considered as being of Oceanian origin the bottle-gourd, Lagenaria vulgaris, may be noted. A study of the preparation and uses of the different gourd species found in America, combined with comparisons with those of Oceania and the Far East, would therefore be highly interesting in the way of contributing towards a solution of the question of trans-Pacific influence in pre-Columbian times upon the New World. Thereby we might perhaps obtain a clear view as to which preparative methods, etc., pertained to the bottle-gourd, and which to such calabash species as are indigenous to America. Any inventions, and other particulars that possibly in a remote past were introduced into America along with the Lagenaria gourd may in most cases quite well have been applied to other calabash species, as well as eventually to other objects of similar nature.

The use of the bottle-gourd as a receptacle for the lime serving as a solvent of the alkaloid in chewing coca or other

vegetable drugs — a practice obtaining both in the New World and the Old — is well known and has frequently been cited by writers believing in cultural intercourse across the Pacific.

A remarkable resemblance does in fact exist between certain calabash boxes of America and China, respectively, which, so far as I know, has not hitherto been pointed out, and possibly may not be of any special importance seeing that it only involves a fairly simple technical detail, but nevertheless may be of some interest.

Nordenskiöld[1] describes a kind of calabash boxes with lids which are not infrequently carved in star-shape. The lid and the calabash are always from one and the same fruit (fig. 27). According to the author cited, these calabash boxes occur among several Chaco tribes, the Quichua Indians, and as far north as the Ijca. In addition he points out that many similar calabashes, although with slightly different lids, have been recovered not only on the Peruvian coast but also on the high plateau at Cuzco, at Capamitas in the borderland between Peru and Bolivia, and in the south at Puna de Jujuy.

In his great work "Kunst und Kultur von Peru", Max Schmidt[2] depicts a typical gourd of this kind with a star-shaped lid, discovered at Chuquitanta on the coast of Peru (fig. 28), as well as two similar ones from Ancon and Ica, respectively, in which the lids are similarly constructed but of a divergent shape.

Nordenskiöld's map of the distribution of these gourd boxes shows their range as being typically of western location. Farther north than the Ijca they are unknown. Accordingly he writes: "Plainly we have to do with a culture element which the Chaco Indians have derived from the western area of civilization." The same may presumably be said of the Ijca, who also possess a great many culture elements in common with the Peruvian cultures.

[1] (1). p. 222.

[2] (3) p. 440, fig. 6.

Calebash boxes with star-shaped lids.

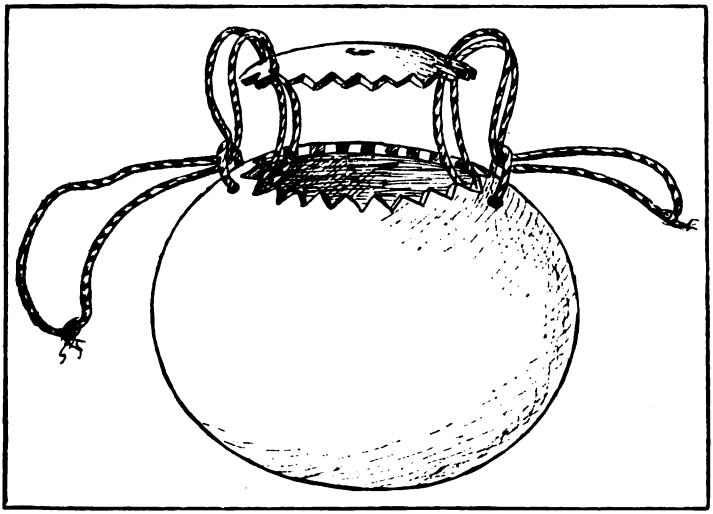

Fig. 27. Ashlushlay. R. M. A. 1304. (× 2/3)

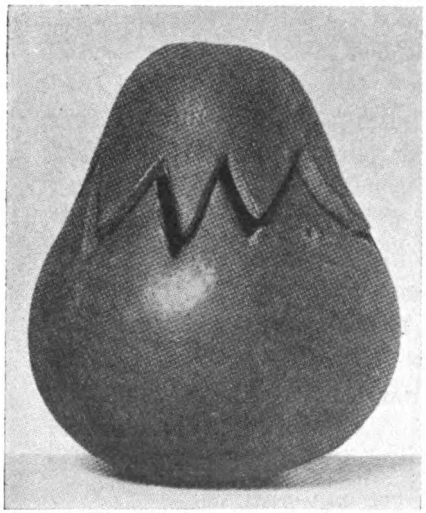

Fig. 28. Chuquitanta. After Max Schmidt. (× 2/3)

Fig. 29. Tsinanfu (China). Prof. F. Jäger's collection. (×2/3)

Certain Amazonian tribes likewise possess a kind of lidded gourd boxes, though these are of a quite different construction.

From the opposite coast of the Pacific I only know of one single example of this kind of gourd box, namely one which quite casually caught my eye in a private collection belonging to Professor Fritz Jäger of Hamburg, who very kindly placed a photograph of it at my disposal (fig. 29).

This box was bought by Prof. Jäger at Tsinanfu, in the province of Shantung. It had been used as a cage for crickets (Orthoptera), "insect musicians". In Berthold Laufer's paper "Insect-musicians and cricket champions of China" there are depicted a number of gourd boxes adapted to the same purpose, but none of them resemble Prof. Jäger's specimen.

It is not, however, improbable that similar stellate gourd lids already occurred in ancient times in China. A Neolithic piece of ceramics, at the Museum of Far Eastern Antiquities, Stockholm, and described by Dr. A. Salmony, seems to point that way (fig. 26). Presumably — or one might say almost certainly — this object originally served as a lid for some sort of vessel which however is missing. It belongs to the Pan Shan group of Kansu.

I am strongly inclined to the belief that the archaeological relic I have just referred to was modelled from the star-shaped lid of a gourd box. In many parts of the world it is not infrequently found that calabashes, baskets, and other receptacles are in a similar manner copied in baked clay.

As I have already said, a comparative study of different calabash species and their uses in America, Oceania and the Far East would prove greatly interesting, particularly if carried out by a botanist and an ethnographer in collaboration.

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AN ARROW POISON WITH CARDIAC EFFECT FROM THE NEW WORLD

BY

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An arrow poison with cardiac effect from the New World

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Arrow poisons with cardiac effect — that is to say, with the effect on the heart that is characteristic of digitalis, Strophanthus etc. — have hitherto been known only from the Old World, namely from Africa and East India. In Equatorial Africa there are various species of Strophanthus, the seeds of which contain *strophanthins*. In Somaliland and to the south thereof, among the Akamba and Ndorobo tribes etc., there occur species of the genus Acocanthera, trees from the wood of which arrow poisons are produced and which contain *ouabain* (*acocantherin*). In south-west Africa Echuja arrow poison is prepared from the sap of a shrub, ADENIUM BOEHMIANUM, from which R. Boehm prepared the poison called *echujin*. All these plants belong to the family of Apocynaceae, the effective substances in them being glucosides. In tropical West Africa, in Guinea, there grows a large tree, ERYTHROPHLOEUM GUINEENSE (of the Leguminosae family), from the thick bark of which, known as the Sassy bark, there is obtained a cardiac arrow poison, whose effective ingredient is the alkaloid *erythrophloein*.

In East India — in Borneo, Java, Celebes and other islands and in the Malay Peninsula — there grows a large tree, ANTIARIS TOXICARIA (Moraceae family), which yields the Ipooh poison, Upas Antiar. This is obtained by

scratching the bark, from which a very poisonous sap exudes and is collected. Concerning this poisonous tree there were in olden times circulated the most gruesome stories, concocted by the savages with the object of terrifying, believed by European travellers and repeated in the literature down towards the end of the eighteenth century. The evaporation of the tree was said to be so poisonous that every living creature that came near it fell down dead. At its foot there dwelt a venomous dragon, who slew every living thing. Erasmus DARWIN, the grandfather of CHARLES DARWIN, described in gruesome colours in a poem the »Hydra Tree of Death» and the terrifying monster.[1] The only effective antidote was the eating of human excrement! — The man who ultimately put an end to this false belief and gave us a real knowledge both of the tree and of the poison was the French explorer LESCHENAULT DE LA TOUR.[2] Later the crystallizing glucoside *antiarin* has been prepared from Antiaris sap.

So much for the cardiac arrow poisons of the Old World. In favourable cases — that is to say, if the arrow penetrates into and wounds a vein, in such a way that the poison comes immediately into the blood — the stronger of them, for instance antiarin or ouabain, can kill especially certain mammals extremely rapidly — in a few minutes or even in a single minute. The animal collapses, almost at the very moment it is hit, with a shriek to the ground in consequence of the fact that the heart has ceased to beat.

Among the peoples of the New World the Indians of South America are especially well known for the use of arrow poisons in the chase and in war. The most widely used poison of this continent, as is well known, is now

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[1] ERASMUS DARVIN, "The Botanic Garden: A Poem", Part II, London 1799, p. *143*. Cited after K. HEDBOM, who has described in detail the interesting history of the Antiaris poison: Arch. f. exp. Path. u. Pharm. 1901, Bd. 45, ss, 317—345.

[2] LESCHENAULT: Annal. du Museum d'hist. natur. T. XV, 1810.

curare, which is obtained from the bark of several Strychnos species which contain *curarines*, alkaloids that throw out of function the end apparatus of the motor nerves in the muscles and thereby cause the game that has been shot to sink down very quickly, paralysed and unable to escape. — In South America, however, — especially in its northern part, which will mainly interest us in the following pages — other things are also used. For instance, in Colombia — and also elsewhere — it happens that people smear arrows with the secretion from the skin of a kind of small frogs, species of the family Phyllobates.[1] By carefully warming the animal near a fire, it is caused to "sweat" profusely. The poison is called by the natives *"vaso"*, *"chaqué"* and *"neará"*. It is stated to evoke a violent local irritation and possibly too a curarine-like effect. The poison is said to be so powerful that it kills even jaguars — under convulsions. (This last statement seems to conflict with the statement that the poison acts like curarine).[2]

Another "arrow poison", which is used by a number of the savages in the northernmost parts of South America — *inter alia* on the River Magdalena and the Goajiro Peninsula (Colombia) — contains as its effective agent *tetanus virus*. The tip of these arrows consists of a spine from a ray. According to information received from the natives, the tip is dipped in a "sauce" of dead and decaying animals — snakes, toads, spiders and the like. Animals or men wounded by such an arrow fall sick after two or three days of violent tetanus and die. The arrows are not used for hunting, as the "poison" is too slow in taking effect, but in war. It is not known whether the tetanus bacilli exist in the mass of decaying animal matter or whether they come on to the arrow tips in some other way. But the course of events indicates that tetanus infection plays its part. G.

[1] L. LEWIN: "Die Pfeilgifte". Leipzig 1923, ss. 426—433.

[2] Cf. E. ST. FAUST: "Tierische Gifte". Heffter's Handb. d. exper. Pharmakol. 1924, Bd. II. 2, s. 1836.

THORELL[1] has cultivated, from matter that had been scraped from such an arrow, bacteria that, at least in most respects, resembled tetanus bacilli, and with such material we have once succeded in producing typical tetanus in a white mouse. According to a statement by LEWIN (l. c.), true curara is also said to be used by several Indian tribes in Colombia.

But the arrow poison of which account is to be given in this paper is neither curare, nor frogs "sweat", nor tetanus virus, but something quite different and something previously unknown. During his latest journey of exploration Professor Baron ERLAND NORDENSKIÖLD has, amongst other places, visited Colombia, especially its western part, and brought home rich collections to the Gothenburg Museum. Nordenskiöld has given the following information with regard to the place where the poison in question was found and the method of its preparation. After passing through the Panama Canal and visiting the Pearl Islands in the Pacific Ocean, he went in his own motor-boat up the Rio Sambú. He there made the acquaintance of a medicine man, *Selimo Huacoríso* — who proved an extremely valuable companion in his journey. Together with this man, he visited, amongst other peoples, some Indians who lived on a little river not shown in the maps, Rio Huruvidá, which falls into the Pacific in the neighbourhood of Puerto Utría. Thanks to Selimo's acquaintance with these Indians, — like them, he belonged to the Emperá tribe of the great Chocó group — Nordenskiöld was enabled in the neighbourhood of the Huruvidá River to witness the preparation of an arrow poison from the trunk of a tree.

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[1] G. THORELL and C. G. SANTESSON: "Ein eigentümliches Pfeilgift aus Goajiro (Kolumbien, Sudamerika)" *Ymer*, Zeitschr. der Schwed. Gesellsch. f. Anthropologie u. Geographie, Jahrg. 1924, Heft. II, ss. 192—199 (in German]. Cf. too Skandinav. Arch. f. Physiol. 1927, Bd. 50, ss. 197—204, and La Medicina germano-hispano-americana, año. 1, num. 11 (julio de 1924), pp 969—975 [in Spanish].

According to the statements of the natives, the tree is very rare. It is tall, with a straight stem, and has towards its base a diameter of about 50 cm. In order to get at the poison, they scratch a spiral groove in the bark (Fig. 1). From this there immediately exudes a rather great amount of a fairly clear sap. In order to collect this rags of bark cloth (woven of bast threads) are stuffed into the groove. The sap which further flows along the groove is collected

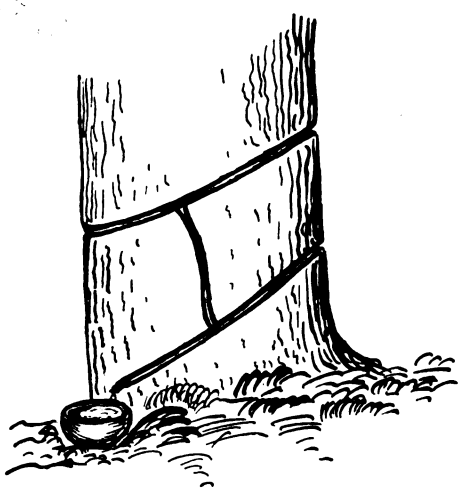

Fig. 1. *Trunk of the Pakarú poison tree,* incised for collecting the poison. After a drawing from the Nordenskiöld expedition.

in a bowl. (If it is desired to get hold of a great deal of poison rapidly, the tree is cut down and the sap that flows out in great quantity is collected). The rags are then picked out carefully and allowed to dry. In this state the poison would seem to keep for an unlimited period. In order to use this dried poison to smear arrow heads with, such a rag is softened in a little water. The sap that has flowed out and been collected in the bowl is evaporated carefully over a slow fire. Fig. 2 shows an Indian "boiling" poison. The sap is in a little bowl which, with the help of three fairly

long wooden rods, is placed a good distance above the fire. The Indian stirs the liquid with a wooden stick.

The poison is called by the Indians *Pakurú-neará*.[1] This latter word is pronounced in a peculiarly nasal manner,

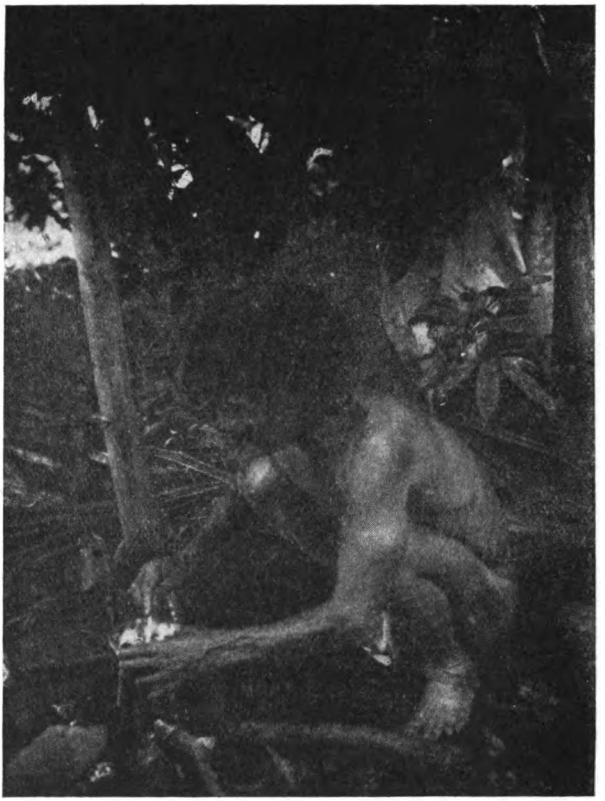

Fig. 2. *Indian of the Emperá tribe* (Chocó group) *"boiling" the Pakurú poison.* After an original photograph from the Nordenskiöld expedition.

the *r* being like a thick *l*. Unfortunately the botanical name of the tree is unknown. Nordenskiöld brought home with him two leaf-bearing saplings which grew under the

[1] It might be observed that *neará* is also the name of the above-mentioned frog venom. "Pakurú-neará" signifies "tree-poison".

poison tree and, from information received, would seem to be offsprings thereof. But they do not permit of a botanical diagnosis. In one of the poison rags there was found a little bit of bark with the adjoining woody tissue,

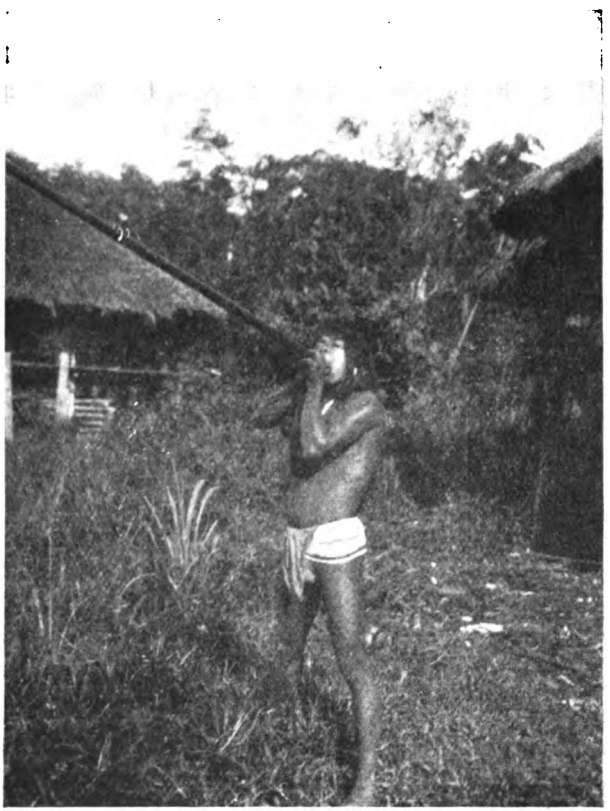

Fig. 3. *Nonamá Indian* (of the Chocó group) *shooting with a blow-pipe.* After an original photograph from the Nordenskiöld expedition.

pretty certainly deriving from the poison tree. A short macroscopic and microscopic description of this material is given below (pp. 10—12).

The poison is used by the natives only for the chase, not in war, and — so far as Nordenskiöld was able to ascertain

— only for the poisoning of *blow-pipe arrows*. The appended figure (Fig. 3) shows a Nonamá Indian (of the Chocó group) shooting with such a blow-pipe. In former times trade was carried on with the poison: the Cuna Indians living on the Atlantic coast at that time obtained poison from the Chocós. As regards the symptoms produced by the poison nothing is known from the country of origin. The circumstance that the poison is used in the chase would seem to indicate that it must work quickly, which indeed it undoubtedly can do. It is stated to be more effective than the frog venom mentioned above. According to the assertions of the Indians, it is ineffective on poultry. As we shall see later on, this statement is of very great interest.

Has anything been previously known about poison of this kind in South America? In a work on the ethnography of that continent Nordenskiöld[1] has, amongst other things, dealt with the question of the history of arrow poisons in South America. From various districts, including Colombia, there are stories both in old and more recent literature about arrow poisons that are said to cause death in a relatively long time — from a few hours up to one to five days. In almost all the more detailed accounts (in Spanish) there are descriptions of how the creatures shot have died "rabiando" — that is to say, almost mad with pain. It is difficult to say how much of all this is to be ascribed to excited imagination; nor is it known whether it is a matter of pain arising from wounds or possibly agonies resulting from suffocation or the like. There is also talk of death in convulsions. With regard to this last symptom one might bear in mind the thought that it might have been caused by tetanus infection.

From the time of the great journeys of discovery to America — that is to say, from the end of the fifteenth and the

[1] E. NORDENSKIÖLD: "The Ethnography of South America seen from Mojós in Bolivia". Comparative ethnographical studies III, Gothenburg, 1924, pp. 52 foll.

beginning of the sixteenth century — there is described as material for the preparation of arrow poison the poisonous sap of a tree known as the »*Manzanilla tree*» (HIPPOMANE MANCINELLA L., Fam. Euphorbiaceae). This tree grows on the West Indian islands, in Guiana and Brazil etc. It contains in all its parts a violently irritant milky sap. Concerning this tree, as of Antiaris, marvellous stories were in circulation in former days. Its exhalation — nay even its shadow — was said to be perilous. Living creatures who, especially during rains and storms, had sought shelter under the tree were said to have been poisoned, and even killed, by its vapours. The actual basis of these very much exaggerated statements would seem to be that people who under the circumstances mentioned happened to come beneath or in the neigbourhood of such a tree had come into contact with broken boughs or branches, in consequence of which the irritant milky sap had caused inflammation of the skin, eczema and the like. Curiously enough, the old yarns as to the great poisonousness of the manzanilla tree have worked their way unto the opera stage, inasmuch as the composer MEYERBEER in his opera »L'Africaine» has caused that tree to play a fatal part. With regard to the manzanilla poison LEWIN (l. c., p. 440) makes the definite statement that, though the poison mentioned can cause local irritation and pain, yet it assuredly cannot be absorbed enough to cause poisoning and death — at least not in the quantities that can make their way into the body in connection with an arrow shot or two. Long ago Juan Pimentel, Governor of the province of Caracas on the northern coast of South America, stated that the manzanilla poison was not by itself particularly effective. As to the cause of the dangerousness of the arrow poison he gives us the information that it is due to a mixture of snakes, frogs, spiders and — menstrual blood (!) — which is also a "good story" —. From what has been cited we may draw the conclusion that the addition of manzanilla sap may provoke local irritation and pain, but that this material is not suited

to form the main component of an arrow poison. And it can have nothing whatever to do with the Pakurú poison brought home by Nordenskiöld, as the latter proves to be entirely without the effect of local irritation.

The poison which during the fifteeenth and sixteenth centuries was in use in the northern parts of South America and also in the lower Amazon region and amongst the Mojós (in Bolivia) cannot, according to Nordenskiöld, have been curare. The poison employed at that time worked more slowly and was not suited for the chase, but only for war. In the older literature mention is seldom made of the use of the blow-pipe, which was only used for hunting. The Indians in these regions possessed no hunting poison at that time. It was probably long after that time that curare spread from Guiana to the upper Amazon valley and other parts of the continent. LEWIN (l. c., p. 431) also points out that in the northern part of South America in olden time the arrow poison used cannot have been curare. Even when the northern coast of Colombia was first trodden by the feet of the Spaniards under LUGO, his followers had painful experiences of such a poison, inasmuch as some of them were struck by poisoned arrows and died in terrible convulsions. These arrows were stated to have been smeared with a vegetable poison. If this statement is correct, and consequently if it could not have been a frog poison or tetanus infection, it would surely be *possible* that the Pakurú poison was already in use at that time. This question will be taken up later, after the effect of the poison mentioned has been described.

Before I proceed to set forth my observations of the Pakurú poison, its chemistry and its effects, a few words will here be given to the appearance and structure of the piece of bark and wood from the poison tree which accompanied the poison and of the botanic characters of the saplings above mentioned.

The piece of bark and wood in question was about 3 cm. long and 2—3 mm. thick, greyish brown on the outside and wood-coloured inside. After being softened for some days in diluted H_3N, transverse and longitudinal

sections were cut with a razor by hand and were examined in glycerine. As the sections were not suited to be photographed I have drawn the appended views with the guidance of the microscopic preparations.

The *transverse sections* (Fig. 4 A): On the outside several layers of thin dark brown flat cells (*cork*, *a*) can be seen. Inside the cork there occurs a thick layer of thin-walled parenchyma (*primary bark*, *bb*), with oval cells somewhat prolonged tangentially. In these small round, mostly simple grains of starch can be seen; but there also occur larger balls composed of three or four grains joined together. Larger oil-like drops and rather numerous narrow, isolated, colourless crystals (needles or pillars) also form

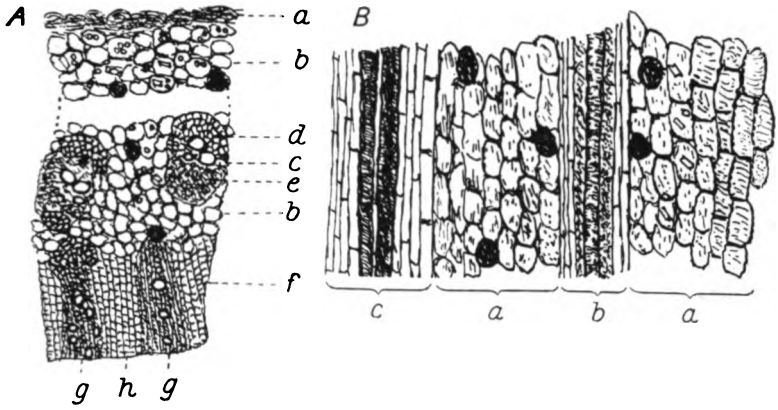

Fig. 4. *Microscopical structure of the poison tree.* A. Transverse section through the bark and wood. B. Radial longitudinal section through bark and wood. *a*, *b*, *c*, etc. see text.

part of the contents of the cells. Here and there round dark brown lumps can be seen — transverse sections of sacs or vessels containing some specific substance — tannin, resin or congealed milky sap(?).

In the inner part of the bark *isolated vascular bundles* are to be seen (*c*) with lightish yellow, thick-walled bast cells (*d*), thickest on the outside and often not forming an entire circle round the soft bast (*e*). On the border between them there lies a group of 3—5 vessels. These show fine spiral lists on the inside. Internally, the bark is bounded by a sharp but undulating border.

In the *wood* (*f*) there can be seen in the convexities of the border-line projecting bundles of woody tissue (*g*, *g*), with a single row or double rows of vessels arranged radially. The troughs of the border-line find their counterpart in broad medullary rays arranged in 8—10 rows (*h*.). The walls of the medullary ray cells, which slope towards each other tangentially, are strongly thickened.

The radial longitudinal section — (Fig. 4 B) without cork — exhibits externally in the axial direction elongated oval cells (*primary bark*, (*a*)). The cells of the outer layers are spirally thickened (like barrel-hoops). In the cells of the primary bark isolated, small grains of starch and needles of crystal can be seen. Isolated cells contain a dark brown clot. In some sections there can be seen in the parenchyma of the bark longitudinal sections of an isolated bundle of vessels (*b*) with elongated, narrow, shiny cells of tough bast externally and internally, and soft bast with vessels in the middle (spiral vessels, sometimes with dark brown content). After that again thin-walled bark parenchyna (*a*) and in the very inside wood with vessels (*c*).

Here too a few words may be devoted to the *saplings with leaves*, which have been found under the poison tree and which are alleged to have come from that tree. The specimens were pressed and seemed to have kept their colours well.

The bark is of a light greyish brown, is puckered longitudinally, has a scarcely appreciable bitter taste and does not give a distinct tannin reaction. The woody cylinder has an ordinary wood colour with radial streaks; and in the centre there is a little pith hollow. The leaves have a short stem (1—4 mm.), are lancet-shaped and 4.5—20 cm. long and 18—45 mm. broad — some of them having an extended point with a fairly even breadth (10—15 mm. long, 1.5—2 mm. broad). At the base of this pointed end there can be seen *in some leaves* on either side a somewhat projecting, three-cornered short lobe. Other leaves lack these side lobes. The edges of the leaves have quite shallow undulations, with an almost unbroken edge. The leaves have feather-like nerves. The lateral nerves anastomose curvedly with one another towards the margin. »The nerves» on the *upper side of the leaf* are darkish brown; the lamellae are mostly dark green. On the under side the leaves are lighter in hue, greyish green with light brown nerves. No hairs are visible on slight magnification. At the base of the larger leaves can be seen stipules, dark brown, partly corneously transparent, stiff, pointed, somewhat bent axially, and of about 8 mm. in length. The leaves have no appreciable smell or taste. — As has been mentioned above, the material here described is not sufficient for a botanical diagnosis.

I proceed to describe the samples of Pakurú poison which Nordenskiöld has placed at my disposal for chemical and toxicological investigation. Accordingly I here use the opportunity of once more expressing to Professor Erland Nordenskiöld my sincere gratitude for the valuable material and for the keen interest he has shown in my work.

The poison was contained, partly desiccated in a calabash bowl, partly in some cloth rags which were kept in a bowl consisting of a coconut shell sawn in two (Fig. 5, *a* and *b*). In bowl *a* there was at the bottom, and to some extent up the sides, in thin layer, a small amount of thoroughly dried-up sap. This was hard, shiny, of a dark yellowish brown,

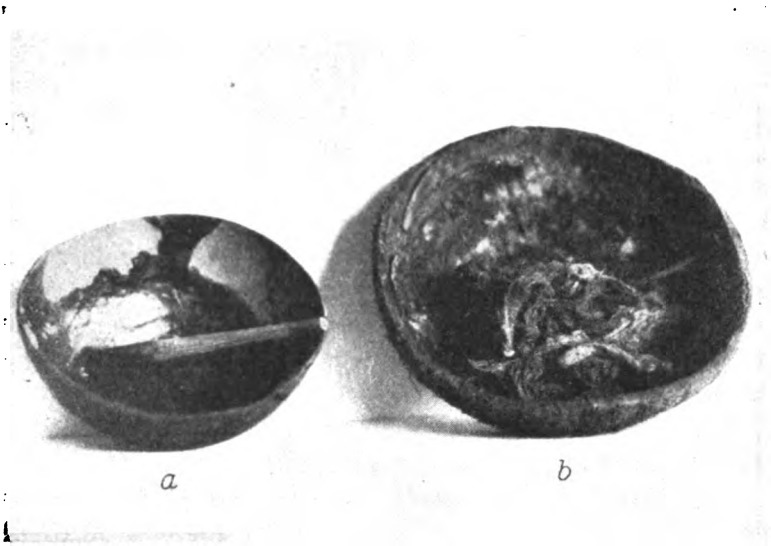

Fig. 5. *Pakurú poison*: a. Dried up in a calabash bowl, in which there is a splinter of wood used for stirring;
b. Dried up in bark cloth rags in a coconut bowl.

and had a faint peculiar smell and an extremely bitter taste, which was quite perceptible even in a dilution of 0.005 %. A little slice of wood was firmly fixed in the dried mass. This slice had served to stir up the mass in the "boiling" of the poison. In the coconut bowl *b* there lay a number of crumpled up bark-cloth rags, quite hard with dried up poison sap and of a colour ranging from dirty grey to yellowish brown. These rags showed the same faint odour and bitter taste as the dried poison in bowl *a*.

The poison mass was almost completely soluble in water and in alcohol. The water solution was of a darker brown colour than the alcohol solution and evidently contained more impurities than the latter. If the alcohol solution was evaporated on a water bath, the residue assumed an appearance that gave the impression of crystals, and microscopically prisms and plates seemed to appear. But, as it turned out later, it was not a question of any real crystallization but of a breaking up of the dried mass into small bits, resembling leaves and prisms.

Other solvents that were tried (Ether, Chloroform, Benzene, Toluol, Benzoylchloride, Butyl- and Amyl-alcohol) did not dissolve, or only dissolved traces of the effective substance. If water was added to a spirit solution of the crude poison, the liquid became turbid, which was certainly due to the presence of *resinous compounds*. Tannin, on the other hand, cannot with the help of chloride of iron be demonstrated in the poison, a fact which does not exclude the possibility that the bark may contain tannin.

The resemblance in the mode of preparation between the Pakurú and the Antiaris poison suggested the idea that there might be some antiarin-like substance present and gave rise to attempts to isolate the substance in question in accordance with the method used by DE VRIJ and LUDWIG[1] for the isolation of antiarin (precipitation of the water solution with acetate of lead, the removal of the lead with H_2S, and concentration of the solution). This method, however, did not lead to crystallization. In its stead was tried R. BOEHM's procedure for the isolation of *echujin*.[2]

An alcohol extract, evaporated to a state of dryness, of the crude poison was dissolved in a small amount of *absolute* alcohol rendered free from water by distillation over calcium, and was then placed in a flask with somewhat more than half its volume of *absolute* ether, rendered free from water by means of distillation over sodium metal. The result

[1] De VRIJ & LUDWIG: Sitzungsber. d. Wiener. Akad. d. Wissensch. 1868, Bd. 57, Abt. II, S. 56.

[2] R. BOEHM: Arch. f. exper. Path. u. Pharmakol., 1890, Bd. 26, S. 169.

was a white flocky precipitation. After twenty-four hours, when the precipitation had largely settled, the liquid was filtered off and once more about half its volume of absolute ether added. A precipitation again arose, which was allowed to settle for twenty-four hours. The same procedure was repeated four times. After that the ether precipitation no longer settled, but exhibited a white turbidity which could not be filtered. After concentration on a water bath of the strong ether-containing alcohol solution, the latter was placed in an exsiccator and gradually a number of balls and stars of characteristic crystals settled. The white ether precipitations were preserved, but after solution in alcohol and standing in an exsiccator they showed little

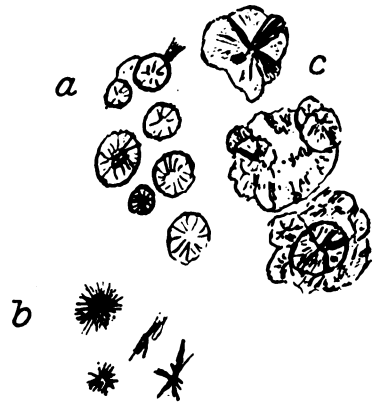

Fig. 6. *Crystal forms of pakurin, a, b, c:* see text.

tendency to crystallize. As experiments on animals showed, the ether precipitation was about as poisonous as the crystalline fraction. To judge by the experiments on animals (p. 177), it is probable that the ether precipitation mainly consisted of the same substance as the crystals, but perhaps including a number of impurities that rendered crystallization difficult.

The *crystals* appearing in the ether-containing alcohol solution revealed themselves, especially on slight magnification, both as round balls with radial streaks (Fig. 6 a), and as stars and bundles of needles (Fig. 6 b). On more powerful magnification, here too balls and bundles of needles appeared, but there were also *thin leaves* (Fig. 6 c), often in cauliflower-like rosettes, and sometimes these, if set on edge, seemed to give the impression of needles. Sometimes there occurred in the same preparation leaf rosettes and long

fine needles quite close to one another; and this probably indicates that there are here two different crystal-forming substances.

It is of interest to note that antiarin and echujin crystallize as lozenge-shaped thin leaves. The Pakurú crystals can be seen only in concentrated (ether-containing) alcohol solution; and the leaves there occurring do not exhibit any definite geometrical shape. At any rate I have not yet been

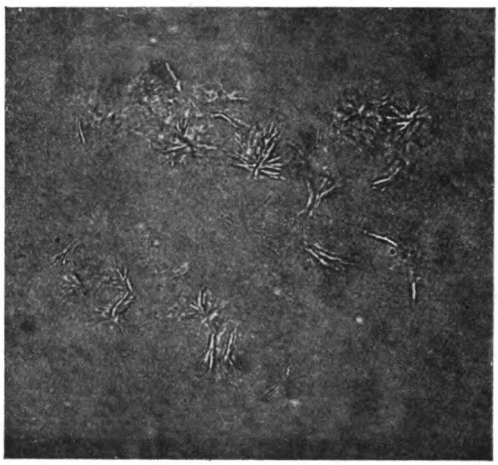

Fig. 7. *Pakurin crystals.* Microphotograph magnified 320 times.

able to establish any such form. In drying or suffusion with ether the crystal form is lost. Fig. 7 shows, though but obscurely, a photographic reproduction of some bundles of crystals, magnified 320 times. Fig. 6 has been drawn from a microscopic preparation.

With this purified, crystallizing, though not perfectly pure preparation, experiments have been made to determine the *melting point.* At about + 160° C the substance sintered together and assumed a brownish hue, but no proper melting occurred even at a considerably higher temperature. This surely was due to the fact that the substance was not in a

sufficiently pure state. The amount of raw material available was not enough for further treatment, as part of it had to be returned to the Gothenburg Museum.

As the effective substance in the Pakurú poison partly reminded, in the matter of crystallization and working, of antiarin and echujin, it was also possible, of course, that, like the substances named, it was a *glucoside*. And indeed this proved to be the case. A water solution of the crude poison extracted with alcohol did not show any appreciable reaction to the TROMMER'S and ALMÉN tests; but after the treatment with HCl in heat for a suitable period, the same tests gave a powerful sugar reaction. The heating with acid had thus split up the *glucoside* and *liberated* sugar.

A portion of the alcohol extract of the Pakurú drug chanced by a mishap to be heated too much, so that it began to be burnt up. This spread a strong smell of caramel in the room — which formed a further evidence that it was a glucoside. The smell was not in the least pungent, from which it appears that there was probably no *nitrogen* in the preparation.

As the crystallizing glucoside here described comes from the Pakurú poison, it may properly be called *pakurin*. It is impossible to decide whether we have here to do with two crystallizing substances and, if so, whether only one or both are vehicles of the characteristic effect.

Attempts to find some charactertistic *colour reaction* to pakurin have not yielded any important results. KELLER'S reaction (solution of the substance in concentrated acetic acid containing iron chloride and the storage of this in a test-tube over concentrated sulphuric acid) gave only a brown "ring" in the surface of contact with a shade of green in its upper layer — not a red ring, such as is given by digitalis glucosides. Pure, crystalline antiarin likewise gives only a brown ring. — If a little dried pakurin is added to a couple of drops of concentrated sulphuric acid containing iron chloride in a watch-glass, the grains of pakurin

immediately assume a bright red colour. If the liquid is stirred with a glass rod, so that the substance is dissolved, the liquid turns a pale yellowish brown. If the same test is carried out with pure antiarin, the grains become brown, and the liquid, after being stirred, becomes first a *bright yellow* (which is characteristic), and later more dark brown. Hence the play of colour with pakurin and with antiarin is different.

After this account of the chemical properties of the Pakurù poison I proceed to a statement as to the *experiments on animals* and their results. These have been carried out both with crude poison and with more or less purified pakurin. The first experiments were made with the substance that had been scraped from the dried-up mass of poison in the calabash bowl (Fig. 5 a). The powder scraped off was crushed with Ringer solution. The greater part was easily dissolved. The remainder (small fragments of bark and impurities) was filtered off. The yellowish and extremely bitter solution had a strength of 1 %, calculated on the basis of the powder weighed — that is to say, ignoring the fact that a small portion of undissolved fragments had been removed. The experiments were carried out on Rana temporaria and on white mice. The poisonous solution was injected subcutaneously. In the frogs the injection canula was inserted through the floor of the mouth into the lymph sac of the abdomen.

The very first experiment revealed the nature of the effect of the Pakurú poison.

Experiment I, 16 Dec. 1927. A frog was given 1 ccm—that is to say, 0.01 gr. — of crude poison subcutaneously. After 8 minutes it was weak and tolerated a supine position; yet it could still turn and even hop, but laxly and clumsily. The movements of the heart could not be observed from without, even if a cylindrical rod were introduced through the mouth down into the oesophagus and raised the heart towards the wall of the chest. No circulation could be observed with a microscope in the vessels of the web of the hindfoot. After one hour the animal was completely paralysed. When the head was cut off, there was no bleeding. When the

animal was pithed there was no twitching. The muscles reacted normally to an induction current. From one motor nerve (sciatic nerve), when such stimulus was applied, there were only weak twitchings, and finally none at all. *The heart had ceased to beat; the ventricle was highly systolic, and the atrium was distended with dark blood.*

This experiment shows the typical working of a *cardiac poison* of the digitalis type. The large dose has caused the heart to cease to beat after a few minutes. The general paralysis is due to the fact that the circulation has ceased.

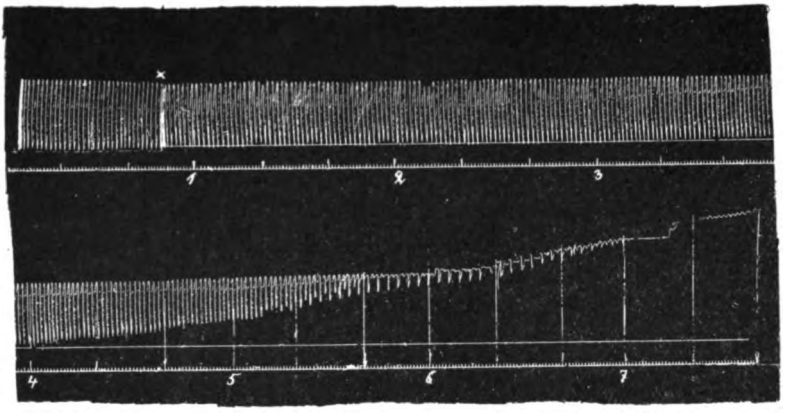

Fig. 8. *Experiment on heart of frog.* Recording with Engelmann's suspension apparatus. Systole upwards. At x the pakurin solution is injected into the lymph sac of one thigh.

The curare-like effect, with regard to the peripheric electric irritability — a weak effect or none from the nerve, normal reaction from the muscles — would seem to have been due to a mere chance, as in other experiments irritability from the nerve proved to be normal. — The nature of the cardiac effect appears more distinctly from the following experiment.

Experiment II, 17 December 1927. Frog. Incision in the neck and pithing. A little short pointed rod of wood (a tapered match) was introduced quickly into the brain cavity to prevent further bleeding. After that the heart was laid open. Pulse: 47 beats a minute. 0.5 ccm. poison solution — that is to say, 5 mg. crude poison — was injected subcutaneously in the lymph sac of the right leg. Very quickly the movements of the ventricle of the heart became peristaltic, and four minutes after the injec-

tion of the poison it came to *a standstill in systole. The atrium continued to beat for a short time.* As much as two hours after the death of the animal nerves and muscles exhibited normal reaction on electric stimulation.

In order to make clear the cardiac effect of the Pakurú poison the contractions of the heart were recorded during one experiment by means of ENGELMANN'S suspension apparatus (Fig. 8). The frog was prepared as in Experiment II. In the apex of the ventricle of the heart there was fixed quite a small metal clip. From this a wire was led over a very easily moved roller just above the heart. From this the wire ran down to the recording arm of the apparatus. By means of a suitable fitting to this of a running weight the heart was lifted from its horizontal position, with the apex upwards. Thus when the heart contracted the point of the recording arm was raised. *Hence the systole was directed upwards.* The beats were magnified about 6 3/4 times.

Experiment III, 23 Febr. 1928. Large and powerful Rana temporaria, male. Solution of *pakurin*, 0.05 %, 1 ccm. (that is 0.5 mg) was injected after a time (Fig. 8 x) into the lymph sac of one thigh. The course of the experiment is shown by the following table and by the figure 8.

Time in min.	Frequency of pulse per min.	Volume of pulse mm	Distance from abscissa in mm		Remarks
			at diastole	at systole	
20″-40″	45	18	0	18	
50″					Injection (Fig. 8 x)
1′-1′20″	45	16.5	0	16.5	
2′-2′20″	45	16-16.5	0	16.5	
3′-3′20″	42	17	0	17.0	
4′-4′20″	45	16.5-14.0	0.5-2.3	16.5	
4′40″-5′	45	12-11	4.5-6.5	17-17.5	
5′-5′20″	39	11-8	7-10	17.5-18	Somewhat irregularly. Varying contraction heights (peristaltic).
5′20″-5′40″	39	8.3-3.4	9.5-15	19	
5′40″-6′	19.5	4.5-3.0	13-15	18	Jump in frequency. Atrium beats twice as fast.
6′-6′20″	18	3.5-3.0	15-16.5	19.5	
6′20″-6′40″	18	4.0-2.5	17-21	21-23.5	Likewise
6′40″-7′	18	2.0-1.0	20-25.5	24-26.5	
7′-7′20»	0	0	26	26	Almost horizontal line.
7′20″-7′40″	0	0	31—33	31—33	Atrium contractions indicated about 39 per minute.

The fourth and fifth columns of the table (reckoned from the left), like a glance at Fig. 8, show how the systole of the ventricle of the heart increases more and more, while the diastole rapidly declines and finally vanishes — that is to say, that the contractions of the ventricle cease. Before that irregularities have made their appearance: peristaltic and »jump in frequency», that is to say the frequency of the beats of the pulse suddenly falls to half — all of which are phenomena that are usual in the working of poisons in the digitalis group.

In connection with the attempts to produce crystalline pakurin (see p. 170—171) we obtained partly a crystallizing fraction (an alcohol solution with a large content of ether), partly white ether precipitations. It was a matter of interest to investigate whether the crystallizing preparation was substantially more poisonous than the precipitations. After evaporation to a state of dryness the two fractions were dissolved separately in Ringer solution, and with these experiments were carried out on Temporariae in order to establish the minimum lethal doses. It proved that 0.5 mg per kilo of the crystallizing preparation caused death, while 0.32 mg. did not. The minimum lethal dose may therefore be estimated as about 0.4 mg per kilo. Of the ether precipitations 0.49 mg per kilo caused death, while 0.4 and 0.32 mg per kilo did not. Even if the crystallizing preparation may be somewhat more poisonous, yet the difference is very insignificant. According to the surmise expressed above, both fractions consist mainly of pakurin. Possibly the ether precipitation contains some impurities that render crystallization difficult.

In order to test whether the higher animals also are sensitive to Pakurú poison some experiments were carried out on white mice, fowls and rabbits.

Experiment IV, 19 December, 1927; white mouse, 17.5 gr. — Crude poison, 0.2 %, 0.3 ccm (0.6 mg.—34 mg per kilo) was injected subcutaneously under the skin of the back. The subject soon became restless, trembled, and was seized with violent convulsions; sometimes made sudden starts; and between them lay still and breathed heavily. Reflexes not increased. Then sank down with convulsions. The breathing became slower and slower, dyspnoeic. Finally occasional weak twitchings. Breathing ceased, and death took place 14 minutes after the injection of the poison. *The heart had ceased to beat and could not be stimulated mechanically.*

Experiment V, 21 December 1927. White mouse, 17 gr. Crude poison, 0.1 %, 0.2 ccm. (that is, 0.2 mg.—11.6 mg. per kilo) subcutaneously.

Distinct weakness soon appeared and a certain difficulty in breathing. About half an hour after injection the animal began to move again, but was still weak. Was again quite well 1 h. 25' after the injection.

Especially in Experiment IV there were sundry nervous symptoms of irritation and paralysis. They can certainly be explained by a rapid decline and the complete cessation, which followed hard upon, of the circulation owing to changes in the activity of the heart and its ceasing to beat. But this does not exclude the possibility that the poison may have had certain direct effects on the central nerve system.

Experiments on fowls were carried out particularly in view of the statements of the Indians that fowls were immune to the Pakurú poison.

A cock (1.925 gr.) and a hen (1.500 gr.) were given subcutaneous injections of pakurin solution under one of the wings. The cock did not react at all to 5 mg. per kilo, the hen hardly at all to 3.3. mg per kilo. After 13.3 mg. per kilo the hen showed distinct exhaustion for some hours and lay mostly on her belly, but recovered completely.

Experiment VI, 13 February 1928. The cock (1.850 gr.) was given subcutaneously crude poison 1 %, 4 ccm.—half under each wing — that is to say, 40 mg. (21.6 mg. per kilo). Died almost immediately without any marked convulsions. Possibly part of the solution had got into a vein.

Experiment VII, 13 February 1928. The hen (1400 gr.) was given a solution of crude poison, 1 %, 1 ccm. subcutaneously — that is to say, 10 mg. (7 mg. per kilo). No symptoms. — An hour and three quarters later 2 ccm. of the same solution — 20 mg (14.3 mg. per kilo). After 45 minutes very much exhausted. 1 h. 15' after the second injection still more powerfully affected: the head sank down; the beak opened and closed rhythmically (difficulty of breathing? Nausea?). The animal rose occasionally and tottered a couple of paces and then collapsed again. About 2 hours after the second injection of poison the head sank but was raised again when the beak reached the plate of the table on which it was resting, after which the head again sank. These slow nodding movements continued for a considerable time, with occasional interruptions. During those intervals the beak mainly rested on the table. The animal could be laid on its side, but soon got up of itself. — Three hours after the second injection a third was administered — 1 ccm. of crude poison solution (1 % — 10 mg. or 7 mg. per kilo). Shortly afterwards vomiting, in which a clear slimy liquid was poured out of the mouth. After that the same symptoms were repeated for several hours. Despite

this the hen had slightly recovered on the following day and later recovered completely, although she had been given altogether 40 mg of crude poison, or 28.6 mg. per kilo, in three doses within five hours.

Fowls are evidently but little susceptible to Pakurú poison, and it would certainly be very difficult to kill them by shooting them with an arrow or two smeared with that poison. In this respect the Indians are undoubtedly right. The same state of things has been proved to exist in the case of the arrow poisons that are prepared from Antiaris and Acocanthera and which contain cardiac poisons of the same type as the Pakurú tree. Fowls are *not*, of course, altogether immune. Doses of crude poison amounting to 20—30 mg per kilo, injected under the skin, bring about severe poisoning or death. As we shall see below, several other animals, such as frogs and rabbits, are much more susceptible to such poisons.

Experiment VIII, 8 February 1928. A small rabbit, 1,200 gr., is given *pakurin* solution, 1 %, 0.6 ccm. (6 mg.—5 mg. per kilo) subcutaneously. It soon becomes weak, the legs straddle apart. Twitchings and general convulsions. Death 5 minutes after the injection. The left ventricle of the heart somewhat, but not maximally, contracted.

Experiment IX, 8 February 1928. Another little rabbit, 1.100 gr., is given *pakurin* solution, 0.1 %, 1.1 ccm. (1 mg. per kilo) subcutaneously. About three quarters of an hour later the animal began to tremble violently. The breathing became laboured. The heart was felt from the outside of the chest to beat slowly but powerfully. The head sank gradually towards the table. A quarter of an hour later the animal lay on its side, could no longer rise, and breathed heavily and slowly. Pulse about 48 per minute. After a few weak twitchings the animal died 1 h 7' after the injection of the poison.

While fowls require over 20 mg. of crude poison per kilo to be killed, 1 mg. per kilo of pakurin suffices to put an end to a rabbit. As we shall see below, the pakurin preparation used by me here is by no means so much more effective than the crude poison as to explain the difference in the fatal dose for fowls and rabbits.

Before I go any further, I should like to say a few words about a phenomenon that appeared in the hen in Exp. VII

and in the rabbit in Exp. IX, namely the *weakness and paralysis of the muscles of the neck*, with the peculiar slow *nodding* movements caused thereby. The same phenomenon appeared after intra-venous injection of a digitalis preparation into a rabbit, and also on the injection of gitalin solution under Dura cerebri in the same animal — this in connection with peculiar convulsions which are probably due to a central-nervous (cerebral) effect of the poison[1]. The rabbits then performed the nodding movements with the head, owing to a weakness in the muscles of the neck which made its appearance early and was relatively isolated, and then passed over into paralysis of those muscles, and the head remained lying with the nose against the table. As has been hinted above, it is possible that some of the convulsive and paralytic phenomena in mice are caused by the working of the poison on the central nervous system, even though it is difficult to distinguish these from secondary effects in the way of weakening and cessation of the circulation by the working of the poison on the heart.

In *experiments with regard to blood-pressure* on a rabbit pakurin brought about *a rise in pressure and a retardation of the pulse*. This rise in pressure, however, was not particularly marked. Intra-venous injections of 0.5 mg., 0.23 mg. and 0.15 mg. per kilo increased the blood-pressure from 100 to 114, from 74 to 96, and from 94 to 110 mm. Hg — that is to say, an increase of 14, 22 and 16 mm. respectively. In one experiment the animal was killed immediately by 2 mg., in another by even 1 mg.

It is of great interest to determine the degree of toxicity of Pakurú crude poison and pakurin for different kinds of animals, and to compare their degree of poisonousness with other cognate cardiac poisons. As the collection of the Pharmocological Institution at Stockholm contained a sample of pure crystalline antiarin, prepared by R. Boehm (Leip-

[1] C. G. Santesson and L. Strindberg: Skandinav. Arch. f. Physiol. 1916, bd. XXXV, ss. 51—100.

TABLE

Determinations of Lethal Doses of Pakurú crude Poison, Pakurin and Antiarin.

Poison	Animal	Weight gr.	Solution per cent	Amount ccm.	Poison dose		Effect	Author
					milligr.	mg. per kilo		
Pakurú crude poison	Rana temporaria	38	0.005	0.57	0.0285	0.75	dies	C. G. S.
» »	» »	27.6	»	0.28	0.0138	0.5	lives	»
				minimum lethal dose.		0.63		
» »	White mouse	17.5	0.2	0.3	0.6	34	dies	»
» »	» »	29.0	0.1	0.725	0.725	25	lives	»
		»		*minimum lethal dose.*		30		
» »	Cock	1,850	1.0	4.0	40.0	22	dies	»
				minimum lethal dose.		22		
Pakurin	R. temp.	38.3	0.005	0.5	0.025	0.65	dies	»
»	»	30(?)	»	0.3	0.015	0.5	lives	»
				minimum lethal dose.		0.6		
»	White mouse	24	0.25	0.96	2.4	100	dies	»
»	» »	28	»	0.9	2.24	80	lives	»
				minimum lethal dose.		90		
»	Rabbit	1,100	0.1	1.1	1.1	1.0	dies	»
				minimum lethal dose.		1.0		
Antiarin	R. temp.	49	0.005	0.35	0.007	0.14	dies	»
				minimum lethal dose.		0.14		
»	Cat	1,600—3,100	—	—	0.5—1.0	0.315	dies	Hedbom
»	R. esculenta	60	—	—	0.03	0.58	dies	»
»	Rabbit	1,000	—	—	1.0	1.0	dies	»
»	Pigeon	370—290	—	—	0.5—0.4	1.37	dies	»
»	Hen	1,375	0.1	8.0 (in two doses)	8.0	5.84	lives	C. G. S.
»	»	»	0.83	4.0	33.2	24.0	dies (quickly)	»
»	White mouse	24.5	0.1	0.5	0.5	20.0	dies	»
»	» »	28.0	0.1	0.5	0.5	17.8	lives	»
				minimum lethal dose.		19		

zig), I undertook some determinations of lethal doses with this poison also, of which such determinations had been previously carried out with the same preparation by HEDBOM[1]. I have carried out quite a number of experiments on frogs and mice, but in the appended table I adduce only the experiments that gave the border values, that is to say, as a rule, one experiment with the smallest fatal dose and one experiment with the largest non-fatal dose. The Pakurú crude poison was taken from the calabash bowl (Fig. 5 a); the pakurin experiments were performed with relatively pure alcohol extract from a poison rag from the coconut bowl. (Fig. 5 b. See Table p. 181).

With regard to the relation between Pakurú crude poison and pakurin, the degree of poisonousness for a frog (R. temporaria) proves to be about equal, while, strangely enough, the crude poison has proved to be about three times more poisonous for white mice than the pakurin. One would have expected, on the contrary, to find the »purified» poison more effective. I do not know how this parodoxical result is to be explained. The preparation of what I have called pakurin for the experiments on animals has been mainly produced by extraction with alcohol and the evaporation of the extract on a water bath — a mode of treatment that can scarcely have injured the effective substance. It is possible, of course, that the crude poison may have contained some matter poisonous to white mice which is not contained in the pakurin. But the amount of material that was at my disposal was not sufficient for the investigation of these questions.

Antiarin is more poisonous, on the whole, than the Pakurú preparation. It is only in the case of rabbits that the smallest fatal dose proves to be the same, namely 1 mg. per kilo. — For both kinds of poison the phenomenon which stands out as most remarkrable is *the very considerable difference in toxicity for various kinds of animals*. Rana tempo-

[1]) K HEDBOM, l. c. p. 325.

raria proves to be decidedly the most sensitive. Antiarin, which has been tried on the largest number of different animals, is most poisonous for the kind of frog mentioned, and next comes the cat, R. esculenta, the rabbit and the pigeon, and is distinctly less for fowls and least for white mice — all being calculated on the basis of the kilo body weight. The common frog is about 135 times more sensitive than the white mouse.

Similar differences had previously been observed with regard to the effect of digitalis poisons on the heart in different animals.[1] While, as has been mentioned, the heart of R. temporaria is extremely sensitive to these substances, the heart of the toad (Bufo vulgaris) turns out to be practically insensitive (*Vulpian*, 1855). As is well known, the heart of esculenta is far more difficult than the heart of temporaria to bring into a state of systolic suspense. The heart of Lacerta viridis reacts in the same way as the temporaria heart. The heart in molluscs and crustaceans is brought to a stillstand, it is true, but without any tendency to systole.

In a work on the effect of *periplocin* — a glucoside that works like the digitalis poisons, from PERIPLOCA GRAECA (Fam. Asclepiadaceæ), which grows on the shores of the Black Sea — MACKEITH[2] has also found remarkable differences in the poisonousness of that substance for different animals. On subcutaneous injection the smallest fatal dose for a cat was 2.5 mg., for a rabbit 10 mg., for R. temporaria 25 mg., and for a rat 480 mg. It is noteworthy that the common frog is less sensitive than the cat and the rabbit. The relatively small sensitiveness of the rat, on the other hand, agrees well with observations as to the effect of other heart tonics on this kind of animal.

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[1]) SCHMIEDEBERG: Grundriss der Pharmakologie, 7te Aufl., Leipzig 1913, S. 306.

[2] MACKEITH: Journal of Pharmacology and Experimental Therapeutics, 1926, Vol. 27, pp. 449—466.

What can be the cause of these very considerable differences in sensitiveness in different animals? On this point we know nothing with certainty. Nevertheless it seems highly probable that they are caused by *chemical* dissimilarities in the hearts of different animals — chiefly with regard to the kind of their albuminous substances. Some of them would seem to find it easier than others, when affected by heart tonics, to pass into a state of rigidity (»Starre»). A similar difference is said to be found with regard to the skeleton muscles in R. temporaria and R. esculenta, inasmuch as the former are brought into a state of "Starre" far more easily than the latter by means of coffein.[1] A comparative chemical investigation of the musculature of the heart in different animals, in which attention was also paid to the effect of cardiac muscle poison on the substances there found, will perhaps yield some contributions towards an understanding of the peculiar dissimilarity here pointed out.

The investigation here published has its greatest interest in the fact that, so far as I know, *a cardiac arrow poison from the New World has here been demonstrated for the first time*, — a poison of the cardiac tonic type.

The poison called Pakurú-neará comes from a tree yet unknown in the west of Colombia. When an incision is made in the bark of the tree, there exudes a poisonous sap, which is collected by the Indians and smeared by them on the blow-pipe arrows used for hunting. The sap contains a very bitter, poisonous, non-nitrogenous glucoside, *pakurin*, which crystallizes in thin leaves or fine needles. Possibly there may be two substances, one crystallizing in leaf form, the other in needle form. In the frog (R. temporaria) the poison brings about the effects on the heart that are typical of the digitalis group. The poisonousness, as in other cardiac tonics, is very different in different kinds of animals —

[1] O. SCHMIEDEBERG: Arch. f. exper. Pathol. u. Pharmakol., 1874, Bd. 2, SS. 62—69.

considerable in temporaria and rabbits, relatively small in fowls and white mice.

Whether the vegetable arrow poisons which are said to have been used in olden times by the Indians in Colombia, and which are said to have been employed in warfare against the intruding Spaniards (p. 166 above) consisted of the Pakurú poison, can hardly be determined with certainty. Among the symptoms of the arrow poison then used is mentioned "terrible convulsions". We do not know the poisonousness of the Pakurú sap for human beings, nor the symptoms that appear in them. If the activity of the heart is rapidly weakened or entirely stopped, asphyxial convulsions make their appearance. But the process is certainly not always so rapid. On the other hand, one must bear in mind that laboured breathing and tormented restlessness in wounded persons as the heart grows weaker may have been described as convulsions. But the present-day use of Pakurú poison exclusively for the chase to some extent tells *against* the supposition that it was formerly employed in war.

APPENDIX.

Yet Another Cardiac Poison from Colombia.

Nordenskiöld's companion in the above-mentioned Colombia journey, Mr. S. LINNÉ, bought yet another sample of arrow poison on the upper Purichá River. But the poison is said to have come from Rio Duăsa, a large affluent of the Rio Baudó, though it is not marked in the usual maps. "As far as I can judge", writes Nordenskiöld in a letter, "this sample also would seem to come from the same tree as the poison previously mentioned and consequently would be the Pakurú poison". In this respect, however, it is impossible to be certain. LINNÉ, moreover, learnt how secretive the Indians are with regard to their arrow poisons. As a mat-

ter of fact he was absolutely forbidden to take with him any material from a poison tree growing by the Rio Piavása.

The sample of poison that is here in question was kept in a calabash bowl (marked 27.27.327.) — 12 cm. in diameter, 4.5 cm. in depth and weighing 77 gr. On the bottom of the bowl there lay a lump of firm, hard, but brittle matter, greyish brown on the surface (dried dust) but brownish black, shiny when broken, and very bitter. When pulverised, this produced a lightish brown powder. From this there was prepared with frog-Ringer a 1 % solution. In spite of heating in the preparation of the solution a large part remained undissolved. The liquid was filtered. The strength of the solution was calculated on the basis of the amount of powder weighed, not on that of the amount of poison that had been dissolved. Experiments on frogs (Rana temporaria) were made with this liquid.

Experiment X, 26 March 1928. Frog, 33 gr. Poison solution 1 %, 0.5 ccm. (that is to say, 5 mg. or 151 mg. per kilo) was injected subcutaneously. After 15—20 minutes the animal became weak, and no longer tried to move from a supine position, frequently opened its mouth as widely as possible (nausea ?). The beating of the heart could not be seen from outside. 30 minutes after the injection, however, sudden violent movements were observed, especially of the hind legs. One got the impression that the animal had temporarily woken up from a narcosis. Between whiles it lay relaxed. Reflexes not increased. About 50 minutes after the injection of the poison the animal appeared to be dead. When the head was cut off there was no bleeding. There was a bloody liquid in the lymph sac of the abdomen. *The heart was at rest with the ventricle in a typical systole.*

Experiment XI, 27 March 1928. Frog, 25,4 gr. Poison solution 0.1 %, 0.1 ccm. (that is to say, 0.1 mg. or 3.94 mg. per kilo) injected subcutaneously at 12 h 28′ p.m. — Evidently limp after only 12 minutes. After about an hour entirely paralysed. Was killed. *The heart in a state of typical systole.*

Experiment XII, 28 March 1928. Frog, 34 gr. Poison solution 0.01 %, 0.3 ccm. (0.03 mg. or 0.9 mg. per kilo) injected subcutaneously at 11 h 28′ a. m. After 2 hours no symptoms; half an hour later somewhat limp. 3 hours after the injection distinctly weak, and made no attempt to move from a supine position. If laid on its back, the animal made some small twitching movements with its hind legs, reminding one of chlonic con-

vulsions in picrotoxin poisoning. Reflexes not increased. Heart still beating. — 5 h 40' after the injection not fully paralysed; breathed, occasionally; a heart beat seen now and then. — The following day normal.

The poison dose administered in Experiment XII (0.9 mg. per kilo) manifestly lies just on the border of the minimum lethal dose. For the Pakurú crude poison that was 0.63 mg. per kilo (see table p. 181 above). In view of the fact that in the case of the poison here being discussed a considerable portion remained undissolved, which could not be taken into account in the determination of the strength of the solution, the toxicity of the two samples of poison would seem to be pretty much the same. The poison here described provoked certain nervous symptoms, amongst others the obvious gaping (nausea?), which were usually not to be seen in the working of the Pakurú poison. Nevertheless it may be said, on the whole, that there is no reason for disbelieving that the arrow poison from Rio Duãsa also comes from the Pakurú tree.

THE ANCIENT PERUVIAN ABACUS

BY

HENRY WASSÉN

The ancient Peruvian Abacus

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As is well known, a most remarkable original manuscript in the Spanish language may be seen in the Royal Library at Copenhagen, the author of which is the Peruvian Indian, D. Felipe Huaman Poma de Ayala. This manuscript,[1] which is entitled "El primer nueva coronica y buen gobierno", consists, apart from its letter-press, of a large number of pen-and-ink sketches, and it is in fact one particular detail found in one of those sketches that has given rise to the following investigation, in which I believe I shall be able to prove that in the Peru of pre-Columbian time computing

[1] No. 2232 of the Old Royal Collection, 1179 pages in-quarto. Unfortunately this manuscript has not yet been published in extenso, but the parts of it that have been preliminarily published by Dr. R. Pietschmann in »Nachrichten von der Königlichen Gesellschaft der Wissenschaften zu Göttingen», 1908, and also by the same author in Part 2 of Proceedings of the 18th Americanist Congress in London 1912, are sufficient to show that this manuscript is of the greatest interest as regards our knowledge of Inca culture. The manuscript appears to have been written between the years 1583 and 1613, and its author has, by word and by picture, composed this account of the Indians, which he has dedicated to King Philip II of Spain. That the author, who unfortunately is otherwise unknown, was a man of importance is beyond any doubt whatever. A considerable number of reproductions, culled from Poma de Ayala's manuscript, which are interesting from the point of view of dress, have been published by Montell in his »Dress and Ornaments in Ancient Peru». As in the present investigation I am exclusively going to deal with one particular detail of the manuscript in question, and as space does not permit of an expansion upon its contents and arrangement, I wish to refer the interested reader to the works above mentioned.

tablets were used as an auxiliary when keeping count by the means of quipus.

Before proceeding further, however, I wish to express my gratitude towards Dr. Carl S. Petersen, Chief Librarian of the Royal Library at Copenhagen, who so kindly has permitted me to photograph and publish the pages of Poma de Ayala's manuscript that are here reproduced. I am also much obliged to my friend Mr. K. G. Tengstrand, M. A., of Gothenburg, for the keen interest he has taken in the present investigation. Mr. Tengstrand is very largely to be credited with the mathematical explanation of the method for using the computing board which will be presented in the following article.

Page 360 in Poma de Ayala's manuscript (fig. 1) is devoted to a picture of *quipucamayoc*, the treasurer of the Inca, who in his hands is holding a quipu. At the top of the picture is the legend: "Cõtador maior i tezorero tauantinsuio quipoc curaca condor-chaua", in which the Quichua title "curaca" indicates the man's high official position in Tauantinsuyo, or the Inca kingdom. From Poma de Ayala's manuscript we learn that this "curaca" was a son of *apo*, a word which in Holguin's Quichua vocabulary[1] is translated as "Señor grande, juez superior". This picture is not the only one in de Ayala's manuscript where similar treasurers and secretaries are depicted with quipus in their hands. Montell[2] reproduces a picture in which a quipu-carrying bailiff appears to be making his report to the Inca, Tupac Yupanqui, and, in addition, there are in the manuscript further representations of similar quipu-carrying officials. What lends particular interest to page 360 is, however, the figure seen in the left-hand bottom corner of the drawing. It is a rectangular figure, consisting of 4 by 5 squares, each systematically marked with a number of circles or dots,

[1] *Diego Gonzáles de Holguin:* Arte y Diccionario Qquechua-Español. Lima 1901, p. 29. (First edition 1608).

[2] *Gösta Montell:* Dress and Ornaments in Ancient Peru. Göteborg 1929, fig. 86.

Fig. 1. Page 360, Huaman Poma de Ayala's manuscript.

some of which are quite empty while others are filled in. It is with this detail of the drawing that we are to occupy ourselves in the following article, for there can be no possible doubt that we have here before us a representation of a computing tablet or an abacus, which, judging from everything, must be a Peruvian invention, the use of which has to my knowledge not formerly been recorded from Peru.

Before proceeding any further we will see what Poma de Ayala himself has to say about quipucamayoc's arithmetical methods and whether in his script he has noted down anything of interest in this connection. In this respect page 361 of the manuscript (fig. 2) immediately attracts the attention. Without any grammatical or orthographical corrections whatever, other than the writing in full of a few abbreviations, we read there as follows: "Contador I Tezorero Contador mayor deto doeste rreyno condorchaua hijo de apo aeste le llamauan tauantinsuyo runaquipoc yncap haziendan chasquicoc tezorero mayor dize que este prencipal tenia grande auilidad para sauer su auilidad el ynga mando contar y numirar ajustar conlos yndios deste rreyno con la lana del cierto taruga enparexaua con lalana alos yndios y enparexaua con una comida llamado quinua contaua la quinua y los yndios fue muy grande su auilidad mejor fuera en papel y tinta — contador mayor hatunhuchaquipoc — contador menor huchuy huchaquipoc — cuentan en tablas — numiran de cien mil y de dies mil y de ciento y de dies hasta llegar auna deto do lo que pasan eneste rreyno lo asienta y fiestas y domingos y meses y años y en cada ciudad y uilla y pueblos de yndios auia estos dichos contadores y tesoreros eneste rreyno y contaua destamanera comensando de uno dos y tres suc — yscay — quinza — taua — pichica — zocta — canchis — puzac — yscon — chunga — yscaychunga — quinzachunga — tauachunga — piscachunga — zoctachunga — canchischunga — pozacchunga — ysconchunga — pachaca — uaranga — chungauaranga — huno — pachacahuno — uarangahuno — pantacachuno."

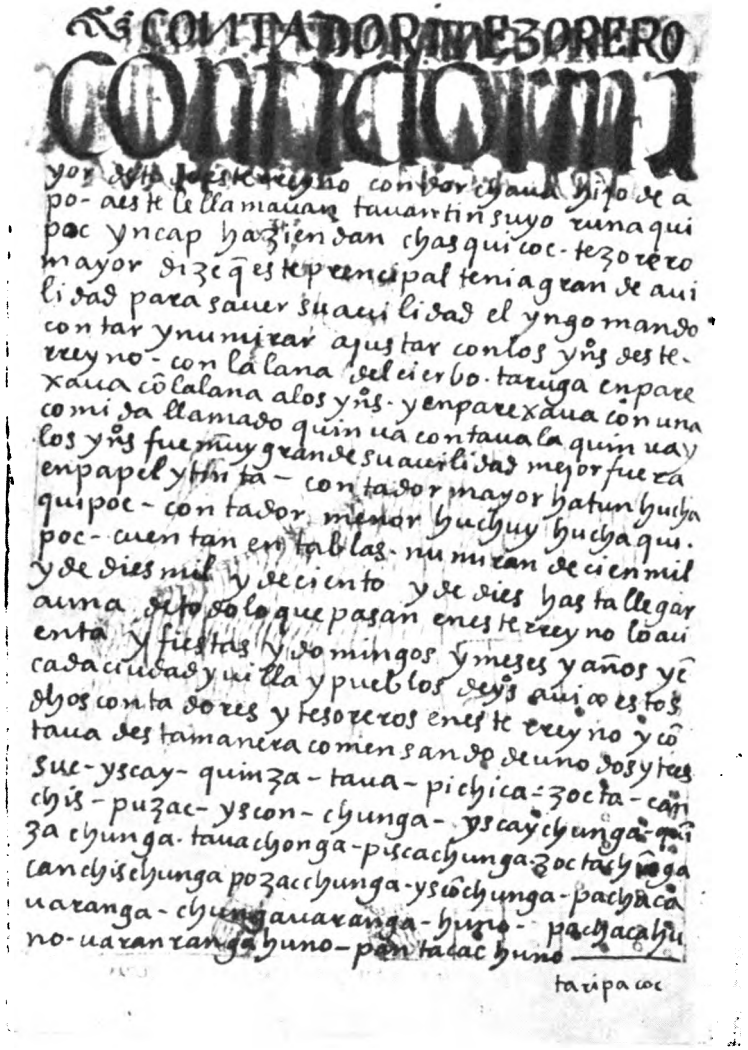

Fig. 2. Page 361, Poma de Ayala.

If we from the author's exceedingly faulty, and with many Quichua words interlarded, Spanish extract the information he there supplies, we learn that (1) the "first reckoner" possessed great ability in his profession, (2) that the Inca sent him out in his kingdom with a commission to carry out computations, that (3) he then added up[1] the Indian population by the aid of the wool of a certain taruga[2] and quinua, and that he was more clever at computation in that way than with paper and ink. We also learn, what is most important as regards the matter here in hand, that the "first reckoner", *hatun huchaquipoc*, and the "second reckoner", *huchuy huchaquipoc*, computed on boards and that they numerated from 1 as far as 100.000. We further learn that similar "bookkeepers" and treasurers were found in all the cities and villages of the realm, and that they kept records of everything that happened, — months and years, as well as feasts and holidays. This information is highly interesting as it strongly corroborates the results arrived at by Nordenskiöld in his quipu investigations, where he has pointed out that the numbers found in the quipus, which have been recovered as grave furniture, frequently are connected with chronology and astronomy.[3] Finally, there is found an enumeration on page 361, in the Quichua language, of the numerals from 1 upward.

Reverting to the figure on page 360, I am of the opinion that it represents an abacus, by the aid of which the Indians were able to work out computations, the results of which were subsequently recorded by knots on the cords of the

[1] The Spanish word emparejar, properly »formar una pareja», signifies »to arrange in pairs»!

[2] *P. Ludovico Bertonio:* Vocabulario de la Lengua Aymara. Leipzig 1879 (1st ed. 1612), Vol. 2, p. 338, »Tarukha: Venado con cuernos, y pelo pardo».

[3] *Erland Nordenskiöld:* The Secret of the Peruvian Quipus *and* Calculations with years and months in the Peruvian Quipus. (Comparative Ethnographical Studies, Vol. 6, 1—2), Göteborg 1925; Le Quipu péruvien du Musée du Trocadéro. (Bulletin du Musée d'Ethnographie du Trocadéro, No. 1.), Paris 1931.

quipus. I beleive that an abacus of this kind consisted of 4 by 5 squares, with 5, 3, 2 and 1 holes, respectively. In computing, pebbles, beans, seeds, or similar objects were put into the holes, so that in this way different numbers could be marked. That pebbles were used as counters is confirmed by the existence, for instance in the Aymara language, of numerous words which specifically relate to this matter. As interesting examples of this I give below a selection from Bertonio's "Vocabulario de la Lengua Aymara." In the Spanish-Aymara part of this work the following expressions occur: —

"*Contar por piedrecitas:* Calana apanocatha, iranocatha, saraatha, vel inocatha." (p. 139)

"*Piedra cuenta para contar lo que se deue:* Cchaara. *Para lo q̃ se ha pagado:* Hanko. *Contar con ellas:* Iranocatha, Apanocatha." (p. 367)

and in the Aymara-Spanish part there are among others: —

"Cchaara: *Piedrecita de contar lo que se deue dela tassa, y otras cosas.*" (p. 72)

"Inocatha: *Contar con piedras.* Calaro inocama." (p. 174)

"Cala paachatha: *Poner dos piedras enla cuenta, quando no ay mas de vna.*" (p. 240)

"Phiscachatha: *Poner cinco en la cuenta quando la hazen por piedrecitas.*" (p. 270)

Velasco who, it is true, writes at a very late date (1789) but evidently had access to certain earlier books that since have disappeared, says that the Caras, living south of Pasto in Ecuador, possessed some sort of system of writing: "Se reducia á ciertos archivos ó depósitos hechos de madera, de piedra ó de barro, con diversas separaciones en las cuales colocaban piedrecillas de distintos tamaños, colores y figuras angulares, porque eran excelentes lapidarios. Con las diversas combinaciones de ellas, perpetuaban sus hechos, y formaban sus cuentas de todo."[1]

[1] *Juan de Velasco:* Historia del Reino de Quito en la America Meridional. Quito 1841, T. II, p. 7.

Rivet and Verneau[1] seem inclined to identify the objects mentioned by Velasco as the objects filled with hollowed squares, described by themselves, that have been archaeologically discovered in Peru and Ecuador; objects which some writers have held to be village plans but, as Nordenskiöld[2] has convincingly shown, are to be looked upon as special gambling boards.

It is very probable that in the description given by Velasco an abacus is referred to, although from the description itself one is unable to get a clear conception thereof. As regards the figure recorded by Poma de Ayala, it is altogether out of the question that it is intended to represent a gambling board. For one thing, this figure carries no resemblance whatever to the gambling boards just referred to, and, for another, it is quite obvious that the figure is connected with the letter-press in such a way there can be no doubt that it is an abacus we have before us. This does not, of course, preclude the possibility that gambling boards have in some way or other originally suggested the invention of the abacus. On the contrary, such may very probably have been the case.

Let us now proceed to an explanation of fig. 3 where I have sketched a system according to which Mr. Tengstrand and I suppose the abacus to have been used. We see that the plate is provided with two sets of coordinates. Of these the vertical ones, e. g. row *A*, operates in accordance with the method by which the decimal system is used in quipu computation and thus directly corresponds to an individual

[1] *P. Rivet* et *R. Verneau:* Ethnographie Ancienne de l'Équateur. Paris 1912, pl. XV., and p. 250: »Nous avons rapporté, d'après Velasco, que les Caras se servaient, pour conserver leurs souvenirs historiques, de casiers à compartiments où ils disposaient des pierres de couleurs et grosseurs diverses. Il est impossible de ne pas établir un rapprochement entre ces objets et les compteurs que nous venons de décrire, car leur emploi repose évidemment sur un principe á peu près identique.»

[2] *Erland Nordenskiöld:* Spieltische aus Peru und Ecuador. (Zeitschrift für Ethnologie), Berlin 1918.

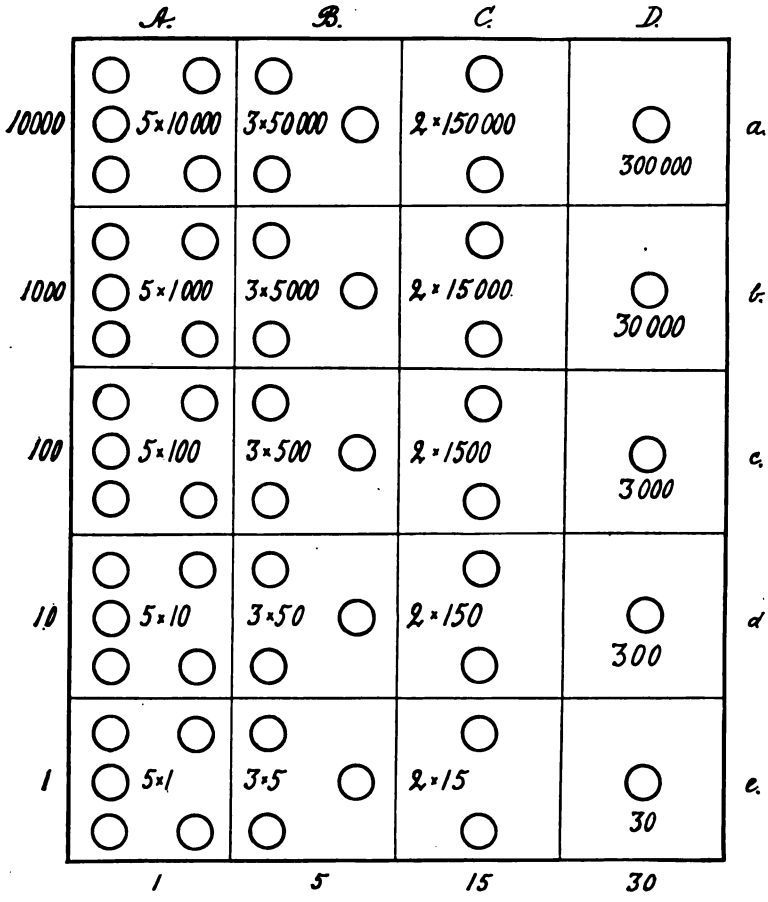

Fig. 3. The Abacus in figure 1. From the explanatory figures will be seen how, for instance in an addition, the different numbers forming the sum may be knotted directly on the quipu cords.

quipu cord in which the knots indicating units are at the bottom, the tens next above them, and so on. By reason of the vertical rows each consisting of five squares, all the numbers contained in the horizontal row *a* become multiples of 10.000.

In regard to the numerical values represented by the horizontal rows, they are based on the important part that the

number 5, i. e. a hand, plays among many peoples, and evidently also in the past has played in the development of the decimal system in Peru. Thus, in the holes found in the square *Ae*, a number of stones, say 3, may be placed in symbolization of the number 3 of a certain unit. Should it be required to mark a further three units the square would be overfilled, wherefore one of the holes in the square *Be* is at once made to substitute five of the units of the square *Ae*, and so on. The example just given is purposely made extremely simple, but we find that in this way sums of addition are automatically reduced so that in consequence the result can be immediately read off in *numbers directly adapted to the knotting system on the quipu cords*. By experiment, anyone can satisfy himself that even very complicated operations of addition can be performed with great rapidity by this method. It may no doubt safely be assumed that the treasurers referred to by Poma de Ayala had attained an expertness in using the computing tablet equalling the dexterity that may be observed in China, Japan or Russia, where abacuses still in use are worked with phenomenal speed and skill.

It is perfectly clear that beside addition the rest of the four simple rules of arithmetic may also be carried out on an abacus constructed in this way. In multiplication, for example, the larger of the two factors is marked on the board the number of times that the multiplier indicates. Reduction and the working out of the result is then carried out according to the same principle used in addition. A similar, though reversed, procedure must be assumed to be employed in division. Operations of division are naturally very time-consuming when worked out by means of an abacus of this type, but they are at any rate not inconceivable. It is, however, an open question whether it is even necessary to suppose that the rule of division was ever practised to any considerable extent in ancient Peru. Lastly, as regards subtraction, this is a very simple operation as long as no

borrowing is necessary. When the computor is under the necessity of borrowing he must effect a reduction into groups of units suitable to borrow from.

If we suppose, as in this case, that the maximum values of the different squares in the vertical row *A* counted from the bottom are 5,50,500, and so on, and if we suppose that a move is consistently made to the right whenever each different square is filled to capacity, we find that the solitary hollows in row *D*, counting from the bottom, denote the values of 30,300,3000, and so on. The importance of these squares in chronological computation by for instance setting down 10 years as equalling 3650 days is no doubt self-evident.

It will be seen that in additions it is quite easy to connote all numbers between 1 and 222.220 merely by using rows *A* and *B*. Then the question arises as to the function of row *C*. If it had none, this would argue against the theory here propounded as to the use of the abacus. We find, however, that as soon as it is a question of higher numbers it becomes very difficult to do without rows *C* and *D*, nota bene if we look for a *fairly easy method of connoting* and computing such numbers. It is also evident, that in order to arrive at the, for chronological computation so important, row *D* — by means of a continuous movement to the right — one must include row *C*.

Here we may, however, leave off the discussion of the method employed in the use of the abacus in order to review the evidence on the basis of which I have arrived at the conlusion that the abacus depicted by Poma de Ayala must constitute an invention independently made by the Indians of ancient Peru. Let us then, to begin with, give a cursory glance at the methods used in the Old World in abacus computation.

The idea of counting with stones on a computing board is of very ancient origin and distributed in many parts of the Old World.

The Greeks had their *abax*. The Romans called their computing tablet *abacus*, a word which I have adopted in this paper so as to avoid confusion with, for instance, the counting-boards for games of chance that are so widely used among the North American Indians. The stones, with which the computing was carried out, were called *calculi*. The *suan-pan*, or computing tray, of the Chinese falls under the same category. Since a great deal has been published with regard to the distribution of computing boards in the the Old World, and since such a literature is no doubt easily obtainable by anyone interested in the subject[1], there is no occasion for me to enter into a discussion of the various views held regarding their origin in the Old World. We have, however, reasons to beleive that it was comparatively late that the Chinese adopted the idea of the *suan-pan* from the west, evidently via India from the ancient civilization area in the Euphrates-Tigris region. The *suan-pan* subsequently gave rise to the *soroban* of the Japanese and the counting frame of the Russians.

As I have said, opinions differ as regards the origin of the abacus. While C. G. Knott writes: "It seems certain that its original home was India, whence it spread westward to Europe and eastward to China, assuming various forms, no doubt, but still remaining essentially the same instrument",[2] Feldhaus says: "Zu den sehr alten chinesischen Erfindungen gehört der Rechenapparat, der aus kleinen Stäben besteht, auf denen sich abgeplattete Kugeln verschieben lassen. Alle Stäbe sind durch eine Querliste in kürzere und längere Abschnitte geteilt. Auf dem kürzeren Stück gilt ein an den Querstab gerückter Knopf 5 Einheiten; auf dem längeren

[1] See for instance the description of different kinds of abacuses given in *History of Mathematics, Vol. II, Special Topics of Elementary Mathematics by D. E. Smith.* Boston 1928, pp. 156—196.

[2] *Cargill G. Knott:* The Abacus, in its historic and scientific aspects. (Transactions of The Asiatic Society of Japan, Vol. XIII), Yokohama 1885, p. 19.

Stück gilt er 1 Einheit. — Von China gelangte dieses Rechenbrett im 16. Jahrhundert nach Russland, wo es heute noch zum Rechnen unentbehrlich ist. Nach Japan kam es aus China im 16. Jahrhundert. Der um die Theorie der Mechanik verdiente und als Erfinder einer Wasser- turbine bekannte Franzose Poncelet lernte das russische Rechenbrett als Kriegsgefangener in den Jahren 1812/14 kennen, machte es in Frankreich bekannt und wurde so der Vater unserer aus Drähten und Kugeln bestehenden Rechenmaschine für Kinder.»[1]

The principle which is common to these computing tablets consists in their being divided into a number of fields by means of vertical grooves in which buttons or similar objects may be slid as counters, or in a set of likewise vertical rods along which perforated balls are slid. The balls forming the initial row — in early times, as to-day in Russia, each row consisted of 10 balls — symbolized units, those of the next row tens, and so on. By degrees this method was simplified by the introduction of a horizontal row, the balls above this row then being made to represent five units each. In order to denote, for instance, the number 99 it was thus only required to employ one »five» and four units in the ten-unit row and an equal number of balls in the one-unit row, while earlier it had been necessary to employ 9 balls in each of these rows.

Cantor supposes the vertical disposal of the different rows or rods to have been the original one, but that gradually a change from vertical to horizontal rows took place; a change which, according to Cantor,[2] had been completed by the end of the 15th century and is represented by the so-called "counting-on-lines" by which computation was prevalently carried out in Europe from the end of the 15th century right into the 17th and, in places, even the 18th century.

[1] *Franz M. Feldhaus:* Die Technik der Antike und des Mittelalters. Leipzig 1931, p. 42.

[2] *M. Cantor:* Mathemathische Beiträge zum Kulturleben der Völker. Halle 1863, p. 143—144.

Knowledge of the methods of computation employed in Europe, more particularly in Spain, in the closing years of the 15th century, is of great importance when it comes to deciding the question whether the abacus depicted by Poma de Ayala should be accepted as an Indian invention. From the information I have been able to gather, there does not appear to have existed any kind of mechanical abacus in Spain, although the "counting-on-lines"-system was commonly used. No direct resemblance between that system and the abacus here adduced from Poma de Ayala's manuscript does, however, exist, a circumstance which argues in favour of the Indian author having described an Indian computing board, an Indian invention. Moreover, it stands to reason that the Indians of the Inca realm must have possessed some appliance to aid them in working out the computations, frequently of a very complicated character, that are found in the unfortunately all too few quipus that have hithertoo been interpreted.

What I have said in the foregoing about the abacus in Peru is in my opinion strongly confirmed by the following information given by the Jesuit father, Acosta, who himself visited Peru at the close of the fifteenth century.

Speaking of varios forms of quipu computation he makes the following observation, here given in a somewhat free translation:

"To see them use another kind of quipu with maize kernels is a perfect joy. In order to effect a very difficult computation for which an able calculator would require pen and ink for the various methods of calculation these Indians make use of their kernels. They place one here, three somewhere else and eight I know not where. They move one kernel here and three there and the fact is that they are able to complete their computation without making the smallest mistake. As a matter of fact, they are better at calculating what each one is due to pay or give than we should be with pen and ink. Whether this is not ingenious and whether

these people are wild animals let those judge who will! What I consider as certain is that in what they undertake to do they are superior to us."[1]

It would be interesting to know if in some museum or other, for instance in Peru, there might be found an abacus of this kind or at least fragments of one. An abacus need, of course, not necessarily have been constructed exclusively in the form of a stone- or earthenware-tablet dotted with depressions, but may quite well have consisted of some far more perishable material such as wood or, perhaps, even cloth.

Just one remark in conclusion: In Poma de Ayala's figure may be noticed certain squares in which all the holes are filled and where consequently no such reduction as the foregoing has been made. The presence of wholly filled squares in Poma de Ayala's figure does not necessarily preclude the explanation here given as to the method of using the abacus. It is quite likely that the draughtsman merely by way of illustrating an example has haphazardly filled in a number of squares without intending to indicate any specified number. He need not himself fully have understood the use of the abacus. By computation it will be found that the number thus filled in by Poma de Ayala in his figure represents 408257.

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[1] *Joseph de Acosta:* Historia Natural y Moral de Las Indias. Madrid 1894. (First edition Sevilla 1590). T. II, p. 167: »— — —; pues verles otra suerte de quipos, que usan de granos de maíz, es cosa que encanta; porque una cuenta muy embarazosa, en que tendrá un muy buen contador que hacer por pluma y tinta, para ver á como les cabe entre tantos, tanto de contribucion, sacando tanto de allá, y añadiendo tanto de acá, con otras cien retartalillas, tomarán estos Indios sus granos, y pondrán uno aquí, tres allá, ocho no sé donde; pasarán un grano de aquí, trocarán tres de allá, y en efecto ellos salen con su cuenta hecha puntualisimamente sin errar un tilde; y mucho mejor se saben ellos poner en cuenta y razon de lo que cabe á cada uno de pagar ó dar, que sabremos nosotros dárselo por pluma y tinta averiguado. Si esto no es ingenio, y si estos hombres son bestias, júzguelo quien quisiere, que lo que yo juzgo de cierta es, que en aquello á que se aplican, nos hacen grandes ventajas.«

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